# i.MX8 HSM API Rev 4.2

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# 1 HSM API

This document is a software referece description of the API provided by the i.MX8 HSM solutions.

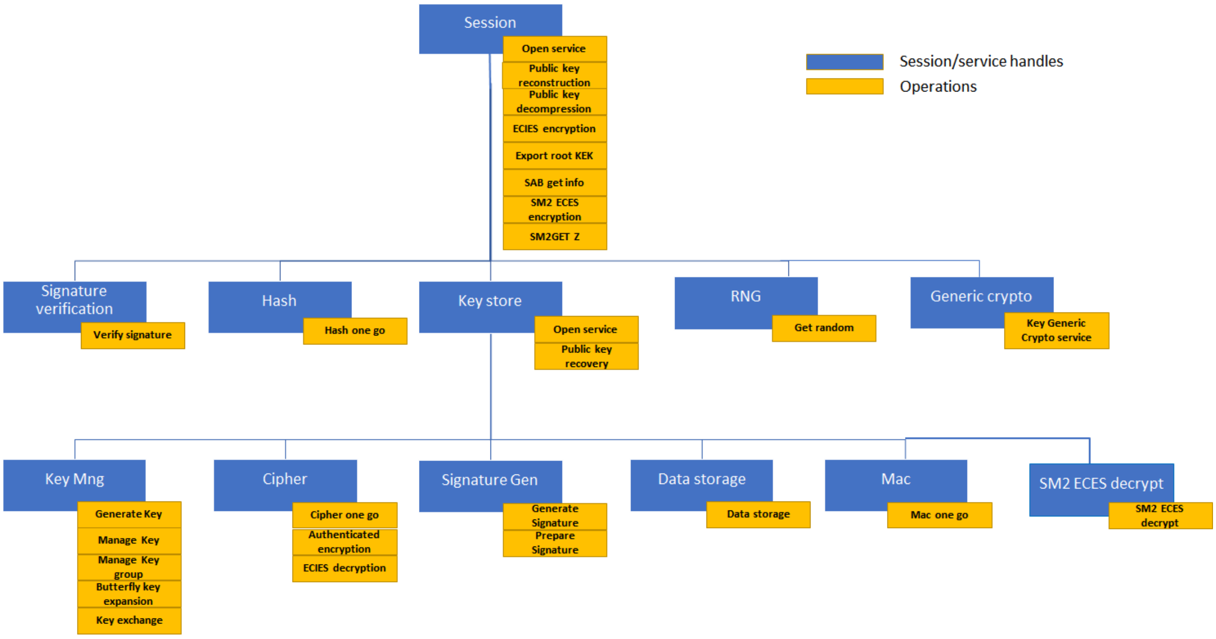
# 2 Revision History

| Revision | date | description |
|---|---|---|
| 0.1 | Mar 29 2019 | Preliminary draft |
| 0.8 | May 24 2019 | It adds the following API:<br>-signature generation<br>-signature verification<br>-rng<br>-hash<br>-butterfly key expansion<br>-ECIES enc/dec<br>-public key reconstruction<br>-public key decompression |
| 0.9 | May 28 2019 | Explicit addresses are replaced by pointers. |
| 1.0 | May 29 2019 | - bug/typos fix.<br>- Change HSM_SVC_KEY_STORE_FLAGS definition |
| 1.1 | July 31 2019 | - hsm_butterfly_key_expansion argument definition: dest_key_identifier is now a pointer.<br>- add error code definition.<br>- improve argument comments clarity |
| 1.5 | Sept 13 2019 | - manage key argument: fix padding size<br>- butterfly key expansion: change argument definition<br>- introduce public key recovery API |
| 1.6 | Oct 14 2019 | - add Key store section in chapter 3<br>- change key_info and flags definition, substitute key_type_ext with group↩_id<br>- hsm_generate_key, hsm_manage_key, hsm_butterfly_key_expansion↩: change argument definition<br>- hsm_manage_key: change argument definition<br>- add hsm_manage_key_group API |

| Revision | date | description |
|---|---|---|
| 1.7 | Dec 20 2019 | - add generic data storage API<br>- add GCM and CMAC support<br>- add support for AES 192/256 key size for all cipher algorithms<br>- add root KEK export API<br>- add key import functionality<br>- add get info API |
| 2.0 | Feb 21 2020 | - fix HSM_KEY_INFO_TRANSIENT definition: delete erroneous "not supported" comment<br>- add Key Encryption Key (HSM_KEY_INFO_KEK) support<br>- key store open service API: adding signed message support for key store reprovisionning<br>- naming consistency: remove "hsm_" prefix from<br>hsm_op_ecies_dec_args_t<br>hsm_op_pub_key_rec_args_t<br>hsm_op_pub_key_dec_args_t<br>hsm_op_ecies_enc_args_t<br>hsm_op_pub_key_recovery_args_t<br>hsm_op_get_info_args_t |
| 2.1 | Apr 16 2020 | - Preliminary version: Add the support of the chinese algorithms and update for i.MX8DXL |
| 2.2 | Apr 30 2020 | - fix erroneous number of supported key groups (correct number is 1000 while 1024 was indicated)<br>- add missing status code definition<br>- remove hsm_open_key_store_service unused flags: HSM_SVC_KEY↩_STORE_FLAGS_UPDATE, HSM_SVC_KEY_STORE_FLAGS_DELETE |
| 2.3 | June 30 2020 | - hsm_get_info fips mode definition: now specifying "FIPS mode of operation" and "FIPS certified part" bits.<br>- Update i.MX8QXP specificities section specifying operations disabled when in FIPS approved mode.<br>- Update comments related to cipher_one_go and SM2 ECES APIs for i.↩MX8DXL |
| 2.4 | July 9 2020 | - clarify support of hsm_import_public key API. |
| 2.5 | July 28 2020 | - add section in "i.MX8QXP specificities" chapter indicating the maximum number of keys per group. |
| 2.6 | Jul 29 2020 | - Key Exchange: add the definition of ECDH_P384 and TLS KDFs<br>- mac_one_go: add definition of HMAC SHA256/384. |
| 2.7 | Sep 25 2020 | - Key Exchange: additional TLS KDFs support, CMAC KDF replaced by SHA-256 KDF<br>- mac_one_go: add support of HMAC SHA224/523. |
| 2.8 | Sep 30 2020 | - Key Exchange: add details related to the SM2 key exchange. |
| 2.9 | Oct 14 2020 | - key_store_open: add STRICT_OPERATION flag. This flag allows to export the key store in the external NVM at the key store creation. |
| 3.0 | Nov 16 2020 | hsm_open_key_store_service: add min_mac_length argument.<br>hsm_mac_one_go - verification: add HSM_OP_MAC_ONE_GO_FLAG↩S_MAC_LENGTH_IN_BITS to represent mac_length in bit.<br>hsm_key_exchange:<br>- enforce new costraints on KEK and TLS key generations<br>- add signed message arguments for KEK generation.<br>- rename HSM_KDF_ALG_SHA_256 in HSM_KDF_ONE_STEP_SHA_↩256.<br>- rename HSM_OP_KEY_EXCHANGE_FLAGS_USE_EPHEMERAL in HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL |
| 3.1 | Nov 20 2020 | Enable support of key_exchange and HMAC on QXP |

| Revision | date | description |
|---|---|---|
| 3.2 | Dec 1 2020 | hsm_generate_key, hsm_manage_key: fix key_group argument wrong description. User must specify the key group for CREATE/UPDATE/DELETE operations. |
| 3.2 Amendement | Feb 3 2021 | Clarify Key_exchange and HMAC support on QXP - both are not supported. |
| 3.3 | Jan 11 2021 | Add hsm_tls_finish API.<br>Update hsm_key_exchange description:<br>- The TLS master_secret is now stored into the key store and accesible by the hsm_tls_finish API<br>- TLS KDF: add support of extended master secret<br>hsm_auth_enc API - GCM encryption (not backward compatible): the IV cannot be fully provided by the user anymore, it must be generated by the HSM instead. |
| 3.4 | Jan 13 2021 | Add support of per-key min mac length using extension commands for key create and key manage. |
| 3.5 | Feb 5 2021 | Clarify hsm_tls_finish support on QXP - not supported. |
| 3.6 | Feb 12 2021 | Key exchange for KEK negotiation supported on QXP, usage of IV flags for auth_enc clarified. |
| 3.7 | Mar 19 2021 | Add HSM_FATAL_FAILURE error code definition |
| 3.8 | April 30 2021 | - hsm_open_key_store_service, hsm_generate_key_ext, hsm_manage↩_key_ext: min_mac_len cannot be set to values $<$ 32 bits when in FIPS approved mode.<br>- Update hsm_key_exchange kdf_input_size argument description in case of TLS Key generation. |
| 3.9 | May 12 2021 | - Butterfly key expansion: add the support of SM2 on DXL<br>- Public key reconstruction: add the support of SM2 on DXL<br>- Introduce standalone Butterfly key expansion API on DXL.<br>- Butterfly key expansion, Public key reconstruction, ECIES enc/dec: remove the support of BR256T1 on DXL.<br>- hsm_prepare_signature: specify max number of stored pre-calculated values.<br>key exchange: add the support of BR256T1 on DXL. |
| 4.0 | Aug 05 2021 | - Authenticated encryption: add the support of SM4 CCM on DXL.<br>- Add key generic cryptographic service API on DXL. |

# 3 General concepts related to the API



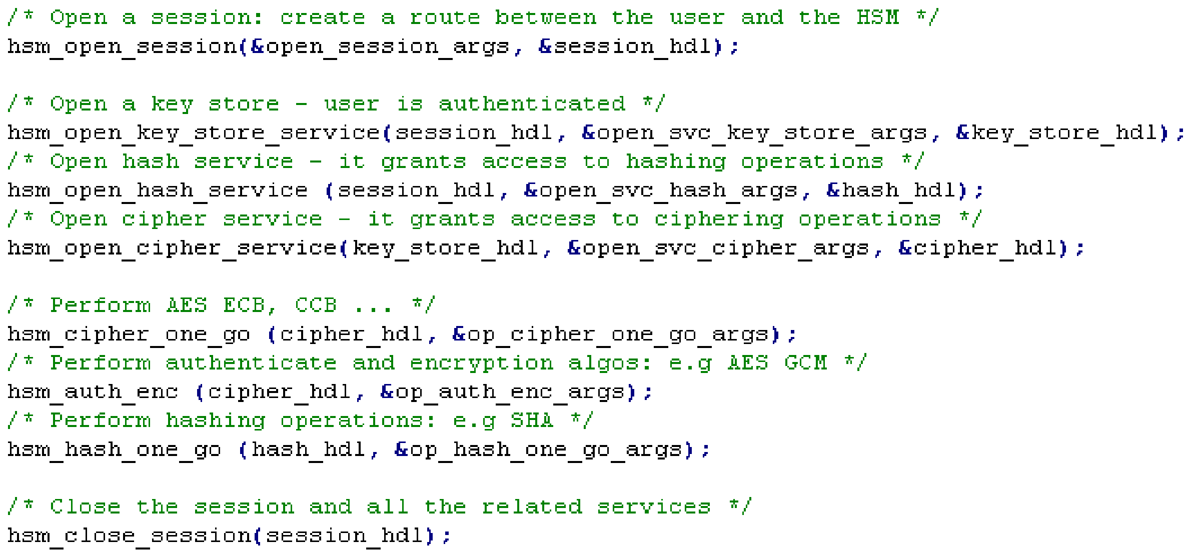
## 3.1 Session

The API must be initialized by a potential requestor by opening a session.
The session establishes a route (MU, DomainID...) between the requester and the HSM. When a session is opened, the HSM returns a handle identifying the session to the requester.

## 3.2 Service flow

For a given category of services, the requestor is expected to open a service flow by invoking the appropriate HSM API.
The session handle, as well as the control data needed for the service flow, are provided as parameters of the call.
Upon reception of the open request, the HSM allocates a context in which the session handle, as well as the provided control parameters are stored and return a handle identifying the service flow.
The context is preserved until the service flow, or the session, are closed by the user and it is used by the HSM to proceed with the sub-sequent operations requested by the user on the service flow.

## 3.3 Example



```
/* Open a session: create a route between the user and the HSM */
hsm_open_session(&open_session_args, &session_hdl);

/* Open a key store - user is authenticated */
hsm_open_key_store_service(session_hdl, &open_svc_key_store_args, &key_store_hdl);
/* Open hash service - it grants access to hashing operations */
hsm_open_hash_service (session_hdl, &open_svc_hash_args, &hash_hdl);
/* Open cipher service - it grants access to ciphering operations */
hsm_open_cipher_service(key_store_hdl, &open_svc_cipher_args, &cipher_hdl);

/* Perform AES ECB, CCB ... */
hsm_cipher_one_go (cipher_hdl, &op_cipher_one_go_args);
/* Perform authenticate and encryption algos: e.g AES GCM */
hsm_auth_enc (cipher_hdl, &op_auth_enc_args);
/* Perform hashing operations: e.g SHA */
hsm_hash_one_go (hash_hdl, &op_hash_one_go_args);

/* Close the session and all the related services */
hsm_close_session(session_hdl);
```

## 3.4 Key store

A key store can be created by specifying the CREATE flag in the hsm_open_key_store_service API. Please note that the created key store will be not stored in the NVM till a key is generated/imported specyfing the "STRICT OPERATION" flag.
Only symmetric and private keys are stored into the key store. Public keys can be exported during the key pair generation operation or recalculated through the hsm_pub_key_recovery API.
Secret keys cannot be exported under any circumstances, while they can be imported in encrypted form.

### 3.4.1 Key management

Keys are divided in groups, keys belonging to the same group are written/read from the NVM as a monolitic block.
Up to 3 key groups can be handled in the HSM local memory (those immediatly available to perform crypto operations), while up to 1000 key groups can be handled in the external NVM and imported in the local memory as needed.
If the local memory is full (3 key groups already reside in the HSM local memory) and a new key group is needed by an incoming user request, the HSM swaps one of the local key group with the one needed by the user request.
The user can control which key group must be kept in the local memory (cached) through the manage_key_group API lock/unlock mechanism.
As general concept, frequently used keys should be kept, when possible, in the same key group and locked in the local memory for performance optimization.

### 3.4.2 NVM writing

All the APIs creating a key store (open key store API) or modyfing its content (key generation, key_management, key derivation functions) provide a "STRICT OPERATION" flag. If the flag is set, the HSM exports the relevant key store blocks into the external NVM and increments (blows one bit) the OTP monotonic counter used as roll back protection. In case of key generation/derivation/update the "STRICT OPERATION" has effect only on the target key

group.
Any update to the key store must be considered as effective only after an operation specifing the flag "STRICT O↩
PERATION" is aknowledged by the HSM. All the operations not specifying the "STRICT OPERATION" flags impact the HSM local memory only and will be lost in case of system reset
Due to the limited monotonic counter size (QXPB0 up to 1620 update available by default), the user should, when possible, perform multiple udates before setting the "STRICT OPERATION" flag (i.e. keys to be updated should be kept in the same key group).
Once the monotonic counter is completely blown a warning is returned on each key store export to the NVM to inform the user that the new updates are not roll-back protected.

## 3.5 Implementation specificities

HSM API is supported on different versions of the i.MX8 family. The API description below is the same for all of them but some features may not be available on some chips. The details of the supported features per chip can be found here:

- for i.MX8QXP: i.MX8QXP specificities
- for i.MX8DXL: i.MX8DXL specificities

# 4 Module Index

## 4.1 Modules

Here is a list of all modules:

# 5 Module Documentation

## 5.1 Session

The API must be initialized by a potential requestor by opening a session.
Once a session is closed all the associated service flows are closed by the HSM.

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct hsm_session_hdl_s
- struct hsm_service_hdl_s
- struct open_session_args_t

### Macros

- #define **HSM_MAX_SESSIONS** (8u)
- #define **HSM_MAX_SERVICES** (32u)
- #define HSM_OPEN_SESSION_PRIORITY_LOW (0x00U)

  *Low priority. default setting on platforms that doesn't support sessions priorities.*
- #define HSM_OPEN_SESSION_PRIORITY_HIGH (0x01U)

  *High Priority session.*
- #define HSM_OPEN_SESSION_FIPS_MODE_MASK (1u << 0)

  *Only FIPS certified operations authorized in this session.*
- #define HSM_OPEN_SESSION_EXCLUSIVE_MASK (1u << 1)

  *No other HSM session will be authorized on the same security enclave.*

- #define HSM_OPEN_SESSION_LOW_LATENCY_MASK (1u << 3)

  *Use a low latency HSM implementation.*
- #define HSM_OPEN_SESSION_NO_KEY_STORE_MASK (1u << 4)

  *No key store will be attached to this session. May provide better performances on some operation depending on the implementation. Usage of the session will be restricted to operations that doesn't involve secret keys (e.g. hash, signature verification, random generation).*
- #define HSM_OPEN_SESSION_RESERVED_MASK ((1u << 2) | (1u << 5) | (1u << 6) | (1u << 7))

  *Bits reserved for future use. Should be set to 0.*

### Typedefs

- typedef uint32_t **hsm_hdl_t**

### Functions

- hsm_err_t hsm_open_session (open_session_args_t ∗args, hsm_hdl_t ∗session_hdl)
- hsm_err_t hsm_close_session (hsm_hdl_t session_hdl)
- struct hsm_session_hdl_s ∗ **session_hdl_to_ptr** (uint32_t hdl)
- struct hsm_service_hdl_s ∗ **service_hdl_to_ptr** (uint32_t hdl)
- void **delete_session** (struct hsm_session_hdl_s ∗s_ptr)
- void **delete_service** (struct hsm_service_hdl_s ∗s_ptr)
- struct hsm_session_hdl_s ∗ **add_session** (void)
- struct hsm_service_hdl_s ∗ **add_service** (struct hsm_session_hdl_s ∗session)

## 5.1.1 Detailed Description

The API must be initialized by a potential requestor by opening a session.
Once a session is closed all the associated service flows are closed by the HSM.

## 5.1.2 Data Structure Documentation

#### Data Fields

| | | |
|---|---|---|
| struct plat_os_abs_hdl ∗ | phdl | |
| uint32_t | session_hdl | |
| uint32_t | mu_type | |

### 5.1.2.1 struct hsm_session_hdl_s

#### Data Fields

| | | |
|---|---|---|
| struct hsm_session_hdl_s ∗ | session | |
| uint32_t | service_hdl | |

### 5.1.2.2 struct hsm_service_hdl_s

**Data Fields**

| | | |
|---|---|---|
| uint32_t | session_hdl | |
| uint8_t | session_priority | Priority of the operations performed in this session. |
| uint8_t | operating_mode | Options for the session to be opened (bitfield). |
| uint8_t | mu_id | index of the MU as per PLAT point of view. |
| uint8_t | interrupt_idx | Interrupt number of the MU used to indicate data availability. |
| uint8_t | tz | indicate if current partition has TZ enabled. |
| uint8_t | did | DID of the calling partition. |

#### 5.1.2.3 struct open_session_args_t

### 5.1.3 Function Documentation

#### 5.1.3.1 hsm_open_session()

```
hsm_err_t hsm_open_session (
        open_session_args_t * args,
        hsm_hdl_t * session_hdl )
```

**Parameters**

| | |
|---|---|
| *args* | pointer to the structure containing the function arguments. |
| *session_hdl* | pointer to where the session handle must be written. |

**Returns**

error_code error code.

#### 5.1.3.2 hsm_close_session()

```
hsm_err_t hsm_close_session (
        hsm_hdl_t session_hdl )
```

Terminate a previously opened session. All the services opened under this session are closed as well

**Parameters**

| | |
|---|---|
| *session_hdl* | pointer to the handle identifying the session to be closed. |

**Returns**

error_code error code.

## 5.2 Key store

User must open a key store service flow in order to perform the following operations:

### Data Structures

- struct open_svc_key_store_args_t

### Macros

- #define HSM_SVC_KEY_STORE_FLAGS_CREATE ((hsm_svc_key_store_flags_t)(1u << 0))

  *It must be specified to create a new key store. The key store will be stored in the NVM only if the STRICT OPERATION flag is set.*
- #define HSM_SVC_KEY_STORE_FLAGS_SET_MAC_LEN ((hsm_svc_key_store_flags_t)(1u << 3))

  *If set, minimum mac length specified in min_mac_length field will be stored in the key store when creating the key store. Must only be set at key store creation.*
- #define HSM_SVC_KEY_STORE_FLAGS_STRICT_OPERATION ((hsm_svc_key_store_flags_t)(1u << 7))

  *The request is completed only when the new key store has been written in the NVM. This applicable for CREATE operations only.*

### Typedefs

- typedef uint8_t **hsm_svc_key_store_flags_t**

### Functions

- hsm_err_t hsm_open_key_store_service (hsm_hdl_t session_hdl, open_svc_key_store_args_t ∗args, hsm_hdl_t ∗key_store_hdl)
- hsm_err_t hsm_close_key_store_service (hsm_hdl_t key_store_hdl)

### 5.2.1 Detailed Description

User must open a key store service flow in order to perform the following operations:

- create a new key store
- perform operations involving keys stored in the key store (ciphering, signature generation...)
- perform a key store reprovisioning using a signed message. A key store re-provisioning results in erasing all the key stores handled by the HSM.

To grant access to the key store, the caller is authenticated against the domain ID (DID) and Messaging Unit used at the keystore creation, additionally an authentication nonce can be provided.

### 5.2.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| uint32_t | key_store_identifier | user defined id identifying the key store. Only one key store service can be opened on a given key_store_identifier. |
| uint32_t | authentication_nonce | user defined nonce used as authentication proof for accesing the key store. |
| uint16_t | max_updates_number | maximum number of updates authorized for the key store. Valid only for create operation.<br>This parameter has the goal to limit the occupation of the monotonic counter used as anti-rollback protection.<br>If the maximum number of updates is reached, HSM still allows key store updates but without updating the monotonic counter giving the opportunity for rollback attacks. |
| hsm_svc_key_store_flags_t | flags | bitmap specifying the services properties. |
| uint8_t | min_mac_length | it corresponds to the minimum mac length (in bits) accepted by the HSM to perform MAC verification operations.<br>Only used upon key store creation when HSM_SVC_KEY_STORE_FLAGS_SET_MAC_LEN bit is set.<br>It is effective only for MAC verification operations with the mac length expressed in bits.<br>It can be used to replace the default value (32 bits).<br>It impacts all MAC algorithms and all key lengths.<br>It must be different from 0.<br>When in FIPS approved mode values $<$ 32 bits are not allowed.<br>Only used on devices implementing SECO FW. |
| uint8_t * | signed_message | pointer to signed_message to be sent only in case of key store re-provisioning |
| uint16_t | signed_msg_size | size of the signed_message to be sent only in case of key store re-provisioning |

#### 5.2.2.1 struct open_svc_key_store_args_t

### 5.2.3 Function Documentation

#### 5.2.3.1 hsm_open_key_store_service()

```
hsm_err_t hsm_open_key_store_service (
        hsm_hdl_t session_hdl,
        open_svc_key_store_args_t * args,
        hsm_hdl_t * key_store_hdl )
```

Open a service flow on the specified key store. Only one key store service can be opened on a given key store.

**Parameters**

| | |
|---|---|
| *session_hdl* | pointer to the handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |
| *key_store_hdl* | pointer to where the key store service flow handle must be written. |

**Returns**

error_code error code.

#### 5.2.3.2 hsm_close_key_store_service()

```
hsm_err_t hsm_close_key_store_service (
        hsm_hdl_t key_store_hdl )
```

Close a previously opened key store service flow. The key store is deleted from the HSM local memory, any update not written in the NVM is lost

**Parameters**

| | |
|---|---|
| *handle* | identifying the key store service flow to be closed. |

**Returns**

error_code error code.

## 5.3 Key management

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct open_svc_key_management_args_t
- struct op_manage_key_group_args_t
- struct op_butt_key_exp_args_t
- struct op_delete_key_args_t
- struct op_get_key_attr_args_t
- struct op_import_key_args_t
- struct kek_enc_key_hdr_t
- struct op_generate_key_ext_args_t
- struct op_generate_key_args_t
- struct op_manage_key_args_t
- struct op_manage_key_ext_args_t

### Macros

- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_CACHE_LOCKDOWN ((hsm_op_manage_key_group_flags_t)(1u << 0))

  *HSM may export the key group in the external NVM to free up the local.*
- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_CACHE_UNLOCK ((hsm_op_manage_key_group_flags_t)(1u << 1))

  *Delete an existing key group.*
- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_DELETE ((hsm_op_manage_key_group_flags_t)(1u << 2))

  *The request is completed only when the update has been written in the NVM.*
- #define **HSM_OP_MANAGE_KEY_GROUP_FLAGS_STRICT_OPERATION** ((hsm_op_manage_key_group_flags_t)(1u << 7))
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_UPDATE ((hsm_op_but_key_exp_flags_t)(1u << 0))

  *User can replace an existing key only by generating a key with the same type of the original one.*
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_CREATE ((hsm_op_but_key_exp_flags_t)(1u << 1))

  *Create a new key.*
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_IMPLICIT_CERTIF ((hsm_op_but_key_exp_flags_t)(0u << 2))

  *butterfly key expansion using implicit certificate.*
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_EXPLICIT_CERTIF ((hsm_op_but_key_exp_flags_t)(1u << 2))

  *butterfly key expansion using explicit certificate.*
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_STRICT_OPERATION ((hsm_op_but_key_exp_flags_t)(1u << 7))

  *The request is completed only when the new key has been written in the NVM.*
- #define **HSM_OP_DEL_KEY_FLAGS_STRICT_OPERATION** ((hsm_op_import_key_flags_t)(1u << 7))
- #define **HSM_OP_IMPORT_KEY_INPUT_E2GO_TLV** ((hsm_op_import_key_flags_t)(1u << 0))
- #define HSM_OP_IMPORT_KEY_INPUT_SIGNED_MSG ((hsm_op_import_key_flags_t)(0u << 0))

  *Bit 1-6: Reserved.*

- #define **HSM_OP_IMPORT_KEY_FLAGS_STRICT_OPERATION** ((hsm_op_import_key_flags_t)(1u << 7))
- #define **HSM_KEY_USAGE_EXPORT** ((hsm_key_usage_t) (1u << 0))
- #define **HSM_KEY_USAGE_ENCRYPT** ((hsm_key_usage_t) (1u << 8))
- #define **HSM_KEY_USAGE_DECRYPT** ((hsm_key_usage_t) (1u << 9))
- #define **HSM_KEY_USAGE_SIGN_MSG** ((hsm_key_usage_t) (1u << 10))
- #define **HSM_KEY_USAGE_VERIFY_MSG** ((hsm_key_usage_t) (1u << 11))
- #define **HSM_KEY_USAGE_SIGN_HASH** ((hsm_key_usage_t) (1u << 12))
- #define **HSM_KEY_USAGE_VERIFY_HASH** ((hsm_key_usage_t) (1u << 13))
- #define **HSM_KEY_USAGE_DERIVE** ((hsm_key_usage_t) (1u << 14))
- #define HSM_KEY_INFO_PERSISTENT ((hsm_key_info_t)(0u << 1))

  *< Persistent keys are stored in the external NVM.*
- #define HSM_KEY_INFO_PERMANENT ((hsm_key_info_t)(1u << 0))

  *Transient keys are deleted when the corresponding key store service flow is.*
- #define HSM_KEY_INFO_TRANSIENT ((hsm_key_info_t)(1u << 1))

  *When set, the key is considered as a master key.*
- #define HSM_KEY_INFO_MASTER ((hsm_key_info_t)(1u << 2))

  *When set, the key is considered as a key encryption key. KEK keys can only.*
- #define **HSM_KEY_INFO_KEK** ((hsm_key_info_t)(1u << 3))
- #define HSM_OP_KEY_GENERATION_FLAGS_UPDATE ((hsm_op_key_gen_flags_t)(1u << 0))

  *< User can replace an existing key only by generating a key with*
- #define **HSM_OP_KEY_GENERATION_FLAGS_CREATE** ((hsm_op_key_gen_flags_t)(1u << 1))
- #define HSM_OP_KEY_GENERATION_FLAGS_STRICT_OPERATION ((hsm_op_key_gen_flags_t)(1u << 7))

  *< The request is completed only when the new key has been written in the NVM.*
- #define HSM_OP_MANAGE_KEY_FLAGS_IMPORT_UPDATE ((hsm_op_manage_key_flags_t)(1u << 0))

  *Import a key and create a new identifier.*
- #define HSM_OP_MANAGE_KEY_FLAGS_IMPORT_CREATE ((hsm_op_manage_key_flags_t)(1u << 1))

  *Delete an existing key.*
- #define HSM_OP_MANAGE_KEY_FLAGS_DELETE ((hsm_op_manage_key_flags_t)(1u << 2))

  *The key to be imported is encrypted using the part-unique root kek.*
- #define HSM_OP_MANAGE_KEY_FLAGS_PART_UNIQUE_ROOT_KEK ((hsm_op_manage_key_flags↩ _t)(1u << 3))

  *The key to be imported is encrypted using the common root kek.*
- #define HSM_OP_MANAGE_KEY_FLAGS_COMMON_ROOT_KEK ((hsm_op_manage_key_flags_t)(1u << 4))

  *The request is completed only when the new key has been written in the NVM.*
- #define **HSM_OP_MANAGE_KEY_FLAGS_STRICT_OPERATION** ((hsm_op_manage_key_flags_t)(1u << 7))

### Typedefs

- typedef uint8_t **hsm_svc_key_management_flags_t**
- typedef uint8_t **hsm_op_manage_key_group_flags_t**
- typedef uint8_t **hsm_op_but_key_exp_flags_t**
- typedef uint8_t **hsm_op_delete_key_flags_t**
- typedef uint8_t hsm_op_import_key_flags_t

  *Bit 0: Defines input configuration.*
- typedef uint32_t **hsm_key_usage_t**
- typedef uint16_t **hsm_key_group_t**
- typedef uint16_t **hsm_key_info_t**
- typedef uint8_t **hsm_op_key_gen_flags_t**
- typedef uint8_t **hsm_op_manage_key_flags_t**
- typedef uint8_t **hsm_op_manage_key_ext_flags_t**

### Enumerations

- enum **hsm_storage_loc_t** { **HSM_SE_KEY_STORAGE** = 0x00000100 }
- enum **hsm_storage_persist_lvl_t** {
  **HSM_VOLATILE_STORAGE** = 0x0,
  **HSM_PERSISTENT_STORAGE** = 0x1,
  **HSM_VOLT_PERM_STORAGE** = 0x80,
  **HSM_PERS_PERM_STORAGE** = 0x81 }
- enum **hsm_key_lifetime_t** {
  **HSM_SE_KEY_STORAGE_VOLATILE** = HSM_SE_KEY_STORAGE | HSM_VOLATILE_STORAGE,
  **HSM_SE_KEY_STORAGE_PERSISTENT** = HSM_SE_KEY_STORAGE | HSM_PERSISTENT_STORAGE,
  **HSM_SE_KEY_STORAGE_VOLT_PERM** = HSM_SE_KEY_STORAGE | HSM_VOLT_PERM_STORAGE,
  **HSM_SE_KEY_STORAGE_PERS_PERM** = HSM_SE_KEY_STORAGE | HSM_PERS_PERM_STORAGE
  }
- enum **hsm_pubkey_type_t** {
  **HSM_PUBKEY_TYPE_RSA** = 0x4001,
  **HSM_PUBKEY_TYPE_ECC_BP_R1** = 0x4130,
  **HSM_PUBKEY_TYPE_ECC_NIST** = 0x4112,
  **HSM_PUBKEY_TYPE_ECC_BP_T1** = 0xC180 }
- enum **hsm_key_type_t** {
  **HSM_KEY_TYPE_ECDSA_NIST_P224** = 0x01,
  **HSM_KEY_TYPE_ECDSA_NIST_P256** = 0x02,
  **HSM_KEY_TYPE_ECDSA_NIST_P384** = 0x03,
  **HSM_KEY_TYPE_ECDSA_NIST_P521** = 0x04,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_224** = 0x12,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256** = 0x13,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_320** = 0x14,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_384** = 0x15,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_512** = 0x16,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_224** = 0x22,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_256** = 0x23,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_320** = 0x24,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_384** = 0x25,
  **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_512** = 0x26,
  **HSM_KEY_TYPE_AES_128** = 0x30,
  **HSM_KEY_TYPE_AES_192** = 0x31,
  **HSM_KEY_TYPE_AES_256** = 0x32,
  **HSM_KEY_TYPE_DSA_SM2_FP_256** = 0x42,
  **HSM_KEY_TYPE_SM4_128** = 0x50,
  **HSM_KEY_TYPE_HMAC_224** = 0x60,
  **HSM_KEY_TYPE_HMAC_256** = 0x61,
  **HSM_KEY_TYPE_HMAC_384** = 0x62,
  **HSM_KEY_TYPE_HMAC_512** = 0x63,
  **HSM_KEY_TYPE_RSA_2048** = 0x71,
  **HSM_KEY_TYPE_RSA_4096** = 0x73 }
- enum **hsm_bit_key_sz_t** {
  **HSM_KEY_SIZE_HMAC_224** = 224,
  **HSM_KEY_SIZE_HMAC_256** = 256,
  **HSM_KEY_SIZE_HMAC_384** = 384,
  **HSM_KEY_SIZE_HMAC_512** = 512,
  **HSM_KEY_SIZE_AES_128** = 128,
  **HSM_KEY_SIZE_AES_192** = 192,
  **HSM_KEY_SIZE_AES_256** = 256,
  **HSM_KEY_SIZE_SM4_128** = 128,
  **HSM_KEY_SIZE_RSA_2048** = 2048,
  **HSM_KEY_SIZE_RSA_4096** = 4096,
  **HSM_KEY_SIZE_ECC_BP_R1_224** = 224,
  **HSM_KEY_SIZE_ECC_BP_R1_256** = 256,

**HSM_KEY_SIZE_ECC_BP_R1_320** = 320,
**HSM_KEY_SIZE_ECC_BP_R1_384** = 384,
**HSM_KEY_SIZE_ECC_BP_R1_512** = 512,
**HSM_KEY_SIZE_ECC_NIST_224** = 224,
**HSM_KEY_SIZE_ECC_NIST_256** = 256,
**HSM_KEY_SIZE_ECC_NIST_384** = 384,
**HSM_KEY_SIZE_ECC_NIST_521** = 521,
**HSM_KEY_SIZE_ECC_BP_T1_224** = 224,
**HSM_KEY_SIZE_ECC_BP_T1_256** = 256,
**HSM_KEY_SIZE_ECC_BP_T1_320** = 320,
**HSM_KEY_SIZE_ECC_BP_T1_384** = 384 }

- enum **hsm_permitted_algo_t** {
**PERMITTED_ALGO_SHA224** = ALGO_HASH_SHA224,
**PERMITTED_ALGO_SHA256** = ALGO_HASH_SHA256,
**PERMITTED_ALGO_SHA384** = ALGO_HASH_SHA384,
**PERMITTED_ALGO_SHA512** = ALGO_HASH_SHA512,
**PERMITTED_ALGO_SM3** = ALGO_HASH_SM3,
**PERMITTED_ALGO_HMAC_SHA256** = ALGO_HMAC_SHA256,
**PERMITTED_ALGO_HMAC_SHA384** = ALGO_HMAC_SHA384,
**PERMITTED_ALGO_CMAC** = ALGO_CMAC,
**PERMITTED_ALGO_CTR** = ALGO_CIPHER_CTR,
**PERMITTED_ALGO_CFB** = ALGO_CIPHER_CFB,
**PERMITTED_ALGO_OFB** = ALGO_CIPHER_OFB,
**PERMITTED_ALGO_ECB_NO_PADDING** = ALGO_CIPHER_ECB_NO_PAD,
**PERMITTED_ALGO_CBC_NO_PADDING** = ALGO_CIPHER_CBC_NO_PAD,
**PERMITTED_ALGO_CCM** = ALGO_CCM,
**PERMITTED_ALGO_GCM** = ALGO_GCM,
**PERMITTED_ALGO_ECDSA_SHA224** = ALGO_ECDSA_SHA224,
**PERMITTED_ALGO_ECDSA_SHA256** = ALGO_ECDSA_SHA256,
**PERMITTED_ALGO_ECDSA_SHA384** = ALGO_ECDSA_SHA384,
**PERMITTED_ALGO_ECDSA_SHA512** = ALGO_ECDSA_SHA512,
**PERMITTED_ALGO_HMAC_KDF_SHA256** = ALGO_HMAC_KDF_SHA256,
**PERMITTED_ALGO_ALL_CIPHER** = ALGO_CIPHER_ALL,
**PERMITTED_ALGO_ALL_AEAD** = ALGO_ALL_AEAD,
**PERMITTED_ALGO_OTH_KEK_CBC** = ALGO_CIPHER_KEK_CBC }
- enum **hsm_key_lifecycle_t** {
**HSM_KEY_LIFECYCLE_OPEN** = 0x1,
**HSM_KEY_LIFECYCLE_CLOSED** = 0x2,
**HSM_KEY_LIFECYCLE_CLOSED_LOCKED** = 0x4 }

### Functions

- hsm_err_t hsm_open_key_management_service (hsm_hdl_t key_store_hdl, open_svc_key_management_args_t ∗args, hsm_hdl_t ∗key_management_hdl)
- hsm_err_t hsm_manage_key_group (hsm_hdl_t key_management_hdl, op_manage_key_group_args_t ∗args)

  *The entire key group will be cached in the HSM local memory.*
- hsm_err_t hsm_butterfly_key_expansion (hsm_hdl_t key_management_hdl, op_butt_key_exp_args_t ∗args)
- hsm_err_t hsm_close_key_management_service (hsm_hdl_t key_management_hdl)
- hsm_err_t hsm_delete_key (hsm_hdl_t key_management_hdl, op_delete_key_args_t ∗args)
- hsm_err_t hsm_get_key_attr (hsm_hdl_t key_management_hdl, op_get_key_attr_args_t ∗args)
- hsm_err_t **hsm_import_key** (hsm_hdl_t key_management_hdl, op_import_key_args_t ∗args)
- hsm_err_t hsm_generate_key_ext (hsm_hdl_t key_management_hdl, op_generate_key_ext_args_t ∗args)
- hsm_err_t hsm_generate_key (hsm_hdl_t key_management_hdl, op_generate_key_args_t ∗args)
- hsm_err_t hsm_manage_key (hsm_hdl_t key_management_hdl, op_manage_key_args_t ∗args)

  *User can replace an existing key only by importing a key with.*
- hsm_err_t hsm_manage_key_ext (hsm_hdl_t key_management_hdl, op_manage_key_ext_args_t ∗args)

### 5.3.1 Detailed Description

### 5.3.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| hsm_svc_key_management_flags_t | flags | bitmap specifying the services properties. |
| uint8_t | reserved[3] | |

#### 5.3.2.1 struct open_svc_key_management_args_t

Data Fields

| | | |
|---|---|---|
| hsm_key_group_t | key_group | it must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API. |
| hsm_op_manage_key_group_flags_t | flags | bitmap specifying the operation properties. |
| uint8_t | reserved | |

#### 5.3.2.2 struct op_manage_key_group_args_t

Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | identifier of the key to be expanded. |
| uint8_t ∗ | expansion_function_value | pointer to the expansion function value input |
| uint8_t ∗ | hash_value | pointer to the hash value input.<br>In case of explicit certificate, the hash value address must be set to 0. |
| uint8_t ∗ | pr_reconstruction_value | pointer to the private reconstruction value input.<br>In case of explicit certificate, the pr_reconstruction_value address must be set to 0. |
| uint8_t | expansion_function_value_size | length in bytes of the expansion function input |
| uint8_t | hash_value_size | length in bytes of the hash value input.<br>In case of explicit certificate, the hash_value_size parameter must be set to 0. |
| uint8_t | pr_reconstruction_value_size | length in bytes of the private reconstruction value input.<br>In case of explicit certificate, the pr_reconstruction_value_size parameter must be set to 0. |
| hsm_op_but_key_exp_flags_t | flags | bitmap specifying the operation properties |
| uint32_t ∗ | dest_key_identifier | pointer to identifier of the derived key to be used for the operation.<br>In case of create operation the new destination key identifier will be stored in this location. |

#### Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | output | pointer to the output area where the public key must be written. |
| uint16_t | output_size | length in bytes of the generated key, if the size is 0, no key is copied in the output. |
| hsm_key_type_t | key_type | indicates the type of the key to be derived. |
| uint8_t | reserved | |
| hsm_key_group_t | key_group | it must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API |
| hsm_key_info_t | key_info | bitmap specifying the properties of the derived key. |

### 5.3.2.3 struct op_butt_key_exp_args_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | < identifier of the key to be used for the operation. bitmap specifying the operation properties. |
| hsm_op_delete_key_flags_t | flags | |

### 5.3.2.4 struct op_delete_key_args_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | < identifier of the key to be used for the operation. indicates which type of key must be generated. |
| hsm_key_type_t | key_type | |
| hsm_bit_key_sz_t | bit_key_sz | |
| hsm_key_lifetime_t | key_lifetime | |
| hsm_key_usage_t | key_usage | |
| hsm_permitted_algo_t | permitted_algo | |
| hsm_key_lifecycle_t | lifecycle | |

### 5.3.2.5 struct op_get_key_attr_args_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | < Identifier of the KEK used to encrypt the key to be imported Address in the requester space where: |
| uint8_t ∗ | input_lsb_addr | Size in bytes of: |
| uint32_t | input_size | bitmap specifying the operation properties. |
| hsm_op_import_key_flags_t | flags | |
| uint8_t ∗ | key_blob | |
| uint32_t | key_blob_sz | |

#### Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | iv | |
| uint16_t | iv_sz | |
| uint16_t | key_group | |
| uint32_t | key_id | |

### 5.3.2.6 struct op_import_key_args_t

#### Data Fields

| | | |
|---|---|---|
| uint8_t | iv[IV_LENGTH] | |
| uint8_t ∗ | key | |
| uint32_t | tag | |

### 5.3.2.7 struct kek_enc_key_hdr_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t ∗ | key_identifier | < pointer to the identifier of the key to be used for the operation. length in bytes of the generated key. |
| uint16_t | out_size | bitmap specifying the operation properties. |
| hsm_op_key_gen_flags_t | flags | indicates which type of key must be generated. |
| hsm_key_type_t | key_type | Key group of the generated key. It must be a value in the range. |
| hsm_key_group_t | key_group | bitmap specifying the properties of the key. |
| hsm_key_info_t | key_info | pointer to the output area where the generated public key must be |
| uint8_t ∗ | out_key | min mac length in bits to be set for this key, value 0 indicates |
| uint8_t | min_mac_len | It must be 0. |
| uint8_t | reserved[3] | |

### 5.3.2.8 struct op_generate_key_ext_args_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t ∗ | key_identifier | < pointer to the identifier of the key to be used for the operation. length in bytes of the generated key. |
| uint16_t | out_size | bitmap specifying the operation properties. |
| hsm_op_key_gen_flags_t | flags | indicates which type of key must be generated. |
| hsm_key_type_t | key_type | Key group of the generated key. |
| hsm_key_group_t | key_group | pointer to the output area where the generated public key |
| uint8_t ∗ | out_key | bitmap specifying the properties of the key. |
| hsm_key_info_t | key_info | |

### 5.3.2.9 struct op_generate_key_args_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t * | key_identifier | < pointer to the identifier of the key to be used for the operation. identifier of the key to be used to decrypt the key to be |
| uint32_t | kek_identifier | length in bytes of the input key area. It must be eqaul to |
| uint16_t | input_size | bitmap specifying the operation properties. |
| hsm_op_manage_key_flags_t | flags | indicates the type of the key to be managed. |
| hsm_key_type_t | key_type | key group of the imported key. It must be a value in |
| hsm_key_group_t | key_group | bitmap specifying the properties of the key, |
| hsm_key_info_t | key_info | pointer to the input buffer. The input buffer is the concatenation |
| uint8_t * | input_data | |

### 5.3.2.10 struct op_manage_key_args_t

#### Data Fields

| | | |
|---|---|---|
| uint32_t * | key_identifier | < pointer to the identifier of the key to be used for the operation. identifier of the key to be used to decrypt the key to be imported |
| uint32_t | kek_identifier | length in bytes of the input key area. It must be eqaul to |
| uint16_t | input_size | bitmap specifying the operation properties. |
| hsm_op_manage_key_flags_t | flags | indicates the type of the key to be managed. |
| hsm_key_type_t | key_type | key group of the imported key. It must be a value in |
| hsm_key_group_t | key_group | bitmap specifying the properties of the key, |
| hsm_key_info_t | key_info | pointer to the input buffer. The input buffer is the concatenation |
| uint8_t * | input_data | min mac length in bits to be set for this key, value 0 indicates |
| uint8_t | min_mac_len | It must be 0. |
| uint8_t | reserved[3] | |

### 5.3.2.11 struct op_manage_key_ext_args_t

## 5.3.3 Macro Definition Documentation

### 5.3.3.1 HSM_OP_IMPORT_KEY_INPUT_SIGNED_MSG

```
#define HSM_OP_IMPORT_KEY_INPUT_SIGNED_M←↩
SG ((hsm_op_import_key_flags_t)(0u << 0))
```

Bit 1-6: Reserved.

Bit 7: Strict: Request completed - New key written to NVM with updated MC.

### 5.3.3.2 HSM_KEY_INFO_PERSISTENT

```
#define HSM_KEY_INFO_PERSISTENT ((hsm_key_info_t)(0u <<
1))
```

< Persistent keys are stored in the external NVM.

When set, the key is permanent (write locked). Once created, it will not

#### 5.3.3.3 HSM_OP_KEY_GENERATION_FLAGS_UPDATE

```
#define HSM_OP_KEY_GENERATION_FLAGS_UPDA↩
TE ((hsm_op_key_gen_flags_t)(1u << 0))
```

< User can replace an existing key only by generating a key with

Create a new key.

### 5.3.4 Function Documentation

#### 5.3.4.1 hsm_open_key_management_service()

```
hsm_err_t hsm_open_key_management_service (
        hsm_hdl_t key_store_hdl,
        open_svc_key_management_args_t * args,
        hsm_hdl_t * key_management_hdl )
```

Open a key management service flow
User must open this service flow in order to perform operation on the key store keys (generate, update, delete)

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *key_management_hdl* | pointer to where the key management service flow handle must be written. |

**Returns**

error_code error code.

#### 5.3.4.2 hsm_manage_key_group()

```
hsm_err_t hsm_manage_key_group (
        hsm_hdl_t key_management_hdl,
        op_manage_key_group_args_t * args )
```

The entire key group will be cached in the HSM local memory.

This command is designed to perform the following operations:

- lock/unlock down a key group in the HSM local memory so that the keys are available to the HSM without additional latency
- un-lock a key group. HSM may export the key group into the external NVM to free up local memory as needed
- delete an existing key group

User can call this function only after having opened a key management service flow.

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.3.4.3 hsm_butterfly_key_expansion()

```
hsm_err_t hsm_butterfly_key_expansion (
        hsm_hdl_t key_management_hdl,
        op_butt_key_exp_args_t * args )
```

This command is designed to perform the butterfly key expansion operation on an ECC private key in case of implicit and explicit certificates. Optionally the resulting public key is exported.
The result of the key expansion function f_k is calculated outside the HSM and passed as input. The expansion function is defined as f_k = f_k_int mod l , where l is the order of the group of points on the curve.
User can call this function only after having opened a key management service flow.

Explicit certificates:

- f_k = expansion function value

out_key = Key + f_k

Implicit certificates:

- f_k = expansion function value,
- hash = hash value used in the derivation of the pseudonym ECC key,
- pr_v = private reconstruction value

out_key = (Key + f_k)∗hash + pr_v

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key store management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.3.4.4 hsm_close_key_management_service()

```
hsm_err_t hsm_close_key_management_service (
        hsm_hdl_t key_management_hdl )
```

Terminate a previously opened key management service flow

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key management service flow. |

**Returns**

error code

### 5.3.4.5 hsm_delete_key()

```
hsm_err_t hsm_delete_key (
        hsm_hdl_t key_management_hdl,
        op_delete_key_args_t * args )
```

This command is designed to perform the following operations:

- delete an existing key

**Parameters**

| | |
|---|---|
| *key_importment_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code Bit 0-6: Reserved. Bit 7: Strict: Request completed - New key written to NVM with updated MC.

### 5.3.4.6 hsm_get_key_attr()

```
hsm_err_t hsm_get_key_attr (
        hsm_hdl_t key_management_hdl,
        op_get_key_attr_args_t * args )
```

This command is designed to perform the following operations:

- get attributes of an existing key

**Parameters**

| | |
|---|---|
| *key_importment_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

### 5.3.4.7 hsm_generate_key_ext()

```
hsm_err_t hsm_generate_key_ext (
        hsm_hdl_t key_management_hdl,
        op_generate_key_ext_args_t * args )
```

Generate a key or a key pair with extended settings. Basic operation is identical to hsm_generate_key, but accepts additional settings. Currently the min_mac_len is the only additional setting accepted.

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

### 5.3.4.8 hsm_generate_key()

```
hsm_err_t hsm_generate_key (
        hsm_hdl_t key_management_hdl,
        op_generate_key_args_t * args )
```

Generate a key or a key pair. Only the confidential keys (symmetric and private keys) are stored in the internal key store, while the non-confidential keys (public key) are exported.

The generated key can be stored using a new or existing key identifier with the restriction that an existing key can be replaced only by a key of the same type.

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

### 5.3.4.9 hsm_manage_key()

```
hsm_err_t hsm_manage_key (
        hsm_hdl_t key_management_hdl,
        op_manage_key_args_t * args )
```

User can replace an existing key only by importing a key with.

This command is designed to perform the following operations:

- import a key creating a new key identifier (import and create)
- import a key using an existing key identifier (import and update)
- delete an existing key

The key encryption key (KEK) can be previously pre-shared or stored in the key store.

The key to be imported must be encrypted by using the KEK as following:

- Algorithm: AES GCM
- Key: root KEK
- AAD = 0
- IV = 12 bytes. When encrypting with a given key, the same IV MUST NOT be repeated. Refer to SP 800-38D for recommendations.
- Tag = 16 bytes
- Plaintext: key to be imported

The hsm_manage_key_ext function (described separately) allows additional settings when importing keys. When using the hsm_manage_key function to import a key, all additional settings are set to their default values

User can call this function only after having opened a key management service flow

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.3.4.10 hsm_manage_key_ext()

```
hsm_err_t hsm_manage_key_ext (
        hsm_hdl_t key_management_hdl,
        op_manage_key_ext_args_t * args )
```

Manage a key or a key pair with extended settings. Basic operation is identical to hsm_manage_key, but accepts additional settings.

Currently the min_mac_len is the only additional setting accepted.

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.4 Ciphering

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_ecies_dec_args_t
- struct op_auth_enc_args_t
- struct open_svc_cipher_args_t
- struct op_cipher_one_go_args_t

### Macros

- #define HSM_AUTH_ENC_ALGO_AES_GCM ((hsm_op_auth_enc_algo_t)(0x00u))

  *Perform SM4 CCM with following constraints:*
- #define **HSM_AUTH_ENC_ALGO_SM4_CCM** ((hsm_op_auth_enc_algo_t)(0x10u))
- #define **HSM_AUTH_ENC_FLAGS_DECRYPT** ((hsm_op_auth_enc_flags_t)(0u << 0))
- #define HSM_AUTH_ENC_FLAGS_ENCRYPT ((hsm_op_auth_enc_flags_t)(1u << 0))

  *Full IV is internally generated (only relevant for encryption)*
- #define HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV ((hsm_op_auth_enc_flags_t)(1u << 1))

  *User supplies 4 bytes of the IV (fixed part), the other bytes are.*
- #define **HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV** ((hsm_op_auth_enc_flags_t)(1u << 2))
- #define **HSM_CIPHER_ONE_GO_ALGO_AES_ECB** ((hsm_op_cipher_one_go_algo_t)(0x00u))
- #define HSM_CIPHER_ONE_GO_ALGO_AES_CBC ((hsm_op_cipher_one_go_algo_t)(0x01u))

  *Perform AES CCM with following constraints:*
- #define **HSM_CIPHER_ONE_GO_ALGO_AES_CCM** ((hsm_op_cipher_one_go_algo_t)(0x04u))
- #define **HSM_CIPHER_ONE_GO_ALGO_SM4_ECB** ((hsm_op_cipher_one_go_algo_t)(0x10u))
- #define **HSM_CIPHER_ONE_GO_ALGO_SM4_CBC** ((hsm_op_cipher_one_go_algo_t)(0x11u))
- #define **HSM_CIPHER_ONE_GO_FLAGS_DECRYPT** ((hsm_op_cipher_one_go_flags_t)(0u << 0))
- #define **HSM_CIPHER_ONE_GO_FLAGS_ENCRYPT** ((hsm_op_cipher_one_go_flags_t)(1u << 0))

### Typedefs

- typedef uint8_t **hsm_op_ecies_dec_flags_t**
- typedef uint8_t hsm_op_auth_enc_algo_t

  *Perform AES GCM with following constraints:*
- typedef uint8_t **hsm_op_auth_enc_flags_t**
- typedef uint8_t **hsm_svc_cipher_flags_t**
- typedef uint8_t **hsm_op_cipher_one_go_algo_t**
- typedef uint8_t **hsm_op_cipher_one_go_flags_t**

### Functions

- hsm_err_t hsm_do_cipher (hsm_hdl_t cipher_hdl, op_cipher_one_go_args_t ∗cipher_one_go)
- hsm_err_t hsm_ecies_decryption (hsm_hdl_t cipher_hdl, op_ecies_dec_args_t ∗args)
- hsm_err_t hsm_auth_enc (hsm_hdl_t cipher_hdl, op_auth_enc_args_t ∗args)
- hsm_err_t hsm_open_cipher_service (hsm_hdl_t key_store_hdl, open_svc_cipher_args_t ∗args, hsm_hdl_t ∗cipher_hdl)
- hsm_err_t hsm_cipher_one_go (hsm_hdl_t cipher_hdl, op_cipher_one_go_args_t ∗args)
- hsm_err_t hsm_close_cipher_service (hsm_hdl_t cipher_hdl)

### 5.4.1 Detailed Description

### 5.4.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | identifier of the private key to be used for the operation |
| uint8_t * | input | pointer to the VCT input |
| uint8_t * | p1 | pointer to the KDF P1 input parameter |
| uint8_t * | p2 | pointer to the MAC P2 input parameter should be NULL |
| uint8_t * | output | pointer to the output area where the plaintext must be written |
| uint32_t | input_size | length in bytes of the input VCT should be equal to 96 bytes |
| uint32_t | output_size | length in bytes of the output plaintext should be equal to 16 bytes |
| uint16_t | p1_size | length in bytes of the KDF P1 parameter should be equal to 32 bytes |
| uint16_t | p2_size | length in bytes of the MAC P2 parameter should be zero reserved for generic use cases |
| uint16_t | mac_size | length in bytes of the requested message authentication code should be equal to 16 bytes |
| hsm_key_type_t | key_type | indicates the type of the used key |
| hsm_op_ecies_dec_flags_t | flags | bitmap specifying the operation attributes. |

#### 5.4.2.1 struct op_ecies_dec_args_t

Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | < identifier of the key to be used for the operation pointer to the user supplied part of initialization vector or nonce, |
| uint8_t * | iv | length in bytes of the fixed part of the initialization vector for |
| uint16_t | iv_size | pointer to the additional authentication data |
| uint8_t * | aad | length in bytes of the additional authentication data |
| uint16_t | aad_size | algorithm to be used for the operation |
| hsm_op_auth_enc_algo_t | ae_algo | bitmap specifying the operation attributes |
| hsm_op_auth_enc_flags_t | flags | pointer to the input area<br>plaintext for encryption |
| uint8_t * | input | pointer to the output area<br>Ciphertext + Tag (16 bytes) |
| uint8_t * | output | length in bytes of the input |
| uint32_t | input_size | length in bytes of the output |
| uint32_t | output_size | |

#### 5.4.2.2 struct op_auth_enc_args_t

Data Fields

| | | |
|---|---|---|
| hsm_hdl_t | cipher_hdl | bitmap specifying the services properties. |
| hsm_svc_cipher_flags_t | flags | |
| uint8_t | reserved[3] | |

#### 5.4.2.3 struct open_svc_cipher_args_t

**Data Fields**

| | | |
|---|---|---|
| uint32_t | key_identifier | < identifier of the key to be used for the operation pointer to the initialization vector (nonce in case of AES CCM) |
| uint8_t * | iv | length in bytes of the initialization vector. |
| uint16_t | iv_size | bitmap specifying the services properties. |
| hsm_svc_cipher_flags_t | svc_flags | bitmap specifying the operation attributes |
| hsm_op_cipher_one_go_flags_t | flags | algorithm to be used for the operation |
| hsm_op_cipher_one_go_algo_t | cipher_algo | pointer to the input area: |
| uint8_t * | input | pointer to the output area: |
| uint8_t * | output | length in bytes of the input. |
| uint32_t | input_size | length in bytes of the output |
| uint32_t | output_size | |

#### 5.4.2.4 struct op_cipher_one_go_args_t

### 5.4.3 Function Documentation

#### 5.4.3.1 hsm_do_cipher()

```
hsm_err_t hsm_do_cipher (
        hsm_hdl_t cipher_hdl,
        op_cipher_one_go_args_t * cipher_one_go )
```

Secondary API to perform ciphering operation
This API does the following:

1. Open an Cipher Service Flow
2. Perform ciphering operation
3. Terminate a previously opened cipher service flow
   User can call this function only after having opened a cipher service flow.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the cipher service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.4.3.2 hsm_ecies_decryption() hsm_err_t hsm_ecies_decryption ( hsm_hdl_t *cipher_hdl*, op_ecies_dec_args_t ∗ *args* )

Decrypt data usign ECIES
User can call this function only after having opened a cipher store service flow.
ECIES is supported with the constraints specified in 1609.2-2016.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.4.3.3 hsm_auth_enc() hsm_err_t hsm_auth_enc ( hsm_hdl_t *cipher_hdl*, op_auth_enc_args_t ∗ *args* )

Perform authenticated encryption operation
User can call this function only after having opened a cipher service flow
For decryption operations, the full IV is supplied by the caller via the iv and iv_size parameters. HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV and HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV flags are ignored. For encryption operations, either HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV or HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV must be set when calling this function:

- When HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV is set, the full IV is internally generated, iv and iv_size must be set to 0
- When HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV is set, the user supplies a 4 byte fixed part of the IV. The other IV bytes are internally generated

**Parameters**

| | |
|---|---|
| *cipher_hdl* | handle identifying the cipher service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.4.3.4 hsm_open_cipher_service() hsm_err_t hsm_open_cipher_service ( hsm_hdl_t *key_store_hdl*, open_svc_cipher_args_t ∗ *args*, hsm_hdl_t ∗ *cipher_hdl* )

- Open a cipher service flow.
- User can call this function only after having opened a key-store service flow.
- User must open this service in order to perform cipher operation.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *cipher_hdl* | pointer to where the cipher service flow handle must be written. |

**Returns**

error code

#### 5.4.3.5 hsm_cipher_one_go()

```
hsm_err_t hsm_cipher_one_go (
          hsm_hdl_t cipher_hdl,
          op_cipher_one_go_args_t * args )
```

Perform ciphering operation
User can call this function only after having opened a cipher service flow

**Parameters**

| | |
|---|---|
| *cipher_hdl* | handle identifying the cipher service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.4.3.6 hsm_close_cipher_service()

```
hsm_err_t hsm_close_cipher_service (
          hsm_hdl_t cipher_hdl )
```

Terminate a previously opened cipher service flow

**Parameters**

| | |
|---|---|
| *cipher_hdl* | pointer to handle identifying the cipher service flow to be closed. |

**Returns**

error code

## 5.5 Signature generation

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct open_svc_sign_gen_args_t
- struct op_generate_sign_args_t
- struct op_prepare_sign_args_t

### Macros

- #define HSM_OP_GENERATE_SIGN_FLAGS_INPUT_DIGEST ((hsm_op_generate_sign_flags_t)(0u << 0))
- #define **HSM_OP_GENERATE_SIGN_FLAGS_INPUT_MESSAGE** ((hsm_op_generate_sign_flags_t)(1u << 0))
- #define HSM_OP_GENERATE_SIGN_FLAGS_LOW_LATENCY_SIGNATURE ((hsm_op_generate_sign_flags_t)(1u << 2))
- #define **HSM_SIGNATURE_SCHEME_ECDSA_NIST_P256_SHA_256** ((hsm_signature_scheme_id_t)0x02u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_NIST_P384_SHA_384** ((hsm_signature_scheme_id_t)0x03u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_NIST_P521_SHA_512** ((hsm_signature_scheme_id_t)0x04u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_256_SHA_256** ((hsm_signature_scheme_id_t)0x13u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384** ((hsm_signature_scheme_id_t)0x14u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_384_SHA_384** ((hsm_signature_scheme_id_t)0x15u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512** ((hsm_signature_scheme_id_t)0x16u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_256_SHA_256** ((hsm_signature_scheme_id_t)0x23u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384** ((hsm_signature_scheme_id_t)0x24u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_384_SHA_384** ((hsm_signature_scheme_id_t)0x25u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512** ((hsm_signature_scheme_id_t)0x26u)
- #define **HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3** ((hsm_signature_scheme_id_t)0x43u)
- #define **HSM_OP_PREPARE_SIGN_INPUT_DIGEST** ((hsm_op_prepare_signature_flags_t)(0u << 0))
- #define **HSM_OP_PREPARE_SIGN_INPUT_MESSAGE** ((hsm_op_prepare_signature_flags_t)(1u << 0))
- #define **HSM_OP_PREPARE_SIGN_COMPRESSED_POINT** ((hsm_op_prepare_signature_flags_t)(1u << 1))

### Typedefs

- typedef uint8_t **hsm_svc_signature_generation_flags_t**
- typedef uint8_t **hsm_op_generate_sign_flags_t**
- typedef uint8_t hsm_signature_scheme_id_t

  *Bit 3 to 7: Reserved.*
- typedef uint8_t **hsm_op_prepare_signature_flags_t**

### Functions

- hsm_err_t hsm_do_sign (hsm_hdl_t key_store_hdl, op_generate_sign_args_t ∗args)
- hsm_err_t hsm_open_signature_generation_service (hsm_hdl_t key_store_hdl, open_svc_sign_gen_args_t ∗args, hsm_hdl_t ∗signature_gen_hdl)
- hsm_err_t hsm_close_signature_generation_service (hsm_hdl_t signature_gen_hdl)
- hsm_err_t hsm_generate_signature (hsm_hdl_t signature_gen_hdl, op_generate_sign_args_t ∗args)
- hsm_err_t hsm_prepare_signature (hsm_hdl_t signature_gen_hdl, op_prepare_sign_args_t ∗args)

### 5.5.1 Detailed Description

### 5.5.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| hsm_hdl_t | signature_gen_hdl | bitmap specifying the services properties. |
| hsm_svc_signature_generation_flags_t | flags | |

#### 5.5.2.1 struct open_svc_sign_gen_args_t

**Data Fields**

| | | |
|---|---|---|
| uint32_t | key_identifier | < identifier of the key to be used for the operation pointer to the input (message or message digest) to be signed |
| uint8_t * | message | pointer to the output area where the signature must be stored. |
| uint8_t * | signature | length in bytes of the output. After signature generation operation, |
| uint16_t | signature_size | length in bytes of the input |
| uint32_t | message_size | identifier of the digital signature scheme to be used |
| hsm_signature_scheme_id_t | scheme_id | bitmap specifying the svc flow attributes |
| hsm_svc_signature_generation_flags_t | svc_flags | bitmap specifying the operation attributes |
| hsm_op_generate_sign_flags_t | flags | |

#### 5.5.2.2 struct op_generate_sign_args_t

**Data Fields**

| | | |
|---|---|---|
| hsm_signature_scheme_id_t | scheme_id | < identifier of the digital signature scheme to be used bitmap specifying the operation attributes |
| hsm_op_prepare_signature_flags_t | flags | |
| uint16_t | reserved | |

#### 5.5.2.3 struct op_prepare_sign_args_t

### 5.5.3 Macro Definition Documentation

#### 5.5.3.1 HSM_OP_GENERATE_SIGN_FLAGS_INPUT_DIGEST

```
#define HSM_OP_GENERATE_SIGN_FLAGS_I←↩
NPUT_DIGEST ((hsm_op_generate_sign_flags_t)(0u << 0))
```

Bit field indicating the requested operations: Bit 0:

- 0: Input is the message digest.
- 1: Input is the actual message.

#### 5.5.3.2 HSM_OP_GENERATE_SIGN_FLAGS_LOW_LATENCY_SIGNATURE

```
#define HSM_OP_GENERATE_←
SIGN_FLAGS_LOW_LATENCY_SIGNATURE ((hsm_op_generate_sign_flags_t)(1u << 2))
```

Bit 2: HSM finalizes the signature by using the artifacts of the previously executed hsm_prepare_signature API. The API fails if no artifacts related to the requested scheme id are available.

### 5.5.4 Function Documentation

#### 5.5.4.1 hsm_do_sign()

```
hsm_err_t hsm_do_sign (
            hsm_hdl_t key_store_hdl,
            op_generate_sign_args_t * args )
```

Secondary API to generate signature on the given message.
This API does the following:

1. Open a service flow for signature generation.
2. Based on the flag to identify the type of message: Digest or actual message, generate the signature using the key corresponding to the key id.
3. Post performing the operation, terminate the previously opened signature-generation service flow.
   User can call this function only after having opened a key-store.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the current key-store. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.5.4.2 hsm_open_signature_generation_service()

```
hsm_err_t hsm_open_signature_generation_service
(
            hsm_hdl_t key_store_hdl,
            open_svc_sign_gen_args_t * args,
            hsm_hdl_t * signature_gen_hdl )
```

Open a signature generation service flow
User can call this function only after having opened a key store service flow.

User must open this service in order to perform signature generation operations.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *signature_gen_hdl* | pointer to where the signature generation service flow handle must be written. |

**Returns**

error code

#### 5.5.4.3 hsm_close_signature_generation_service()

```
hsm_err_t hsm_close_signature_generation_service (
            hsm_hdl_t signature_gen_hdl )
```

Terminate a previously opened signature generation service flow

**Parameters**

| | |
|---|---|
| *signature_gen_hdl* | handle identifying the signature generation service flow to be closed. |

**Returns**

error code

#### 5.5.4.4 hsm_generate_signature()

```
hsm_err_t hsm_generate_signature (
            hsm_hdl_t signature_gen_hdl,
            op_generate_sign_args_t * args )
```

Generate a digital signature according to the signature scheme User can call this function only after having opened a signature generation service flow.

The signature S=(r,s) is stored in the format r||s||Ry where:

- Ry is an additional byte containing the lsb of y. Ry has to be considered valid only if the HSM_OP_GENERATE_SIGN_FLAGS_COMPRESSED_POINT is set.

In case of HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3, message of op_generate_sign_args_t should be (as specified in GB/T 32918):

- equal to Z||M in case of HSM_OP_GENERATE_SIGN_FLAGS_INPUT_MESSAGE
- equal to SM3(Z||M) in case of HSM_OP_GENERATE_SIGN_FLAGS_INPUT_DIGEST

**Parameters**

| | |
|---|---|
| *signature_gen_hdl* | handle identifying the signature generation service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.5.4.5 hsm_prepare_signature()

```
hsm_err_t hsm_prepare_signature (
          hsm_hdl_t signature_gen_hdl,
          op_prepare_sign_args_t * args )
```

Prepare the creation of a signature by pre-calculating the operations having not dependencies on the input message.

The pre-calculated value will be stored internally and used once call hsm_generate_signature. Up to 20 pre-calculated values can be stored, additional preparation operations will have no effects.

User can call this function only after having opened a signature generation service flow.

The signature S=(r,s) is stored in the format r||s||Ry where:

- Ry is an additional byte containing the lsb of y, Ry has to be considered valid only if the HSM_OP_PREPARE_SIGN_COMPRESSED_POINT is set.

**Parameters**

| | |
|---|---|
| *signature_gen_hdl* | handle identifying the signature generation service flow |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.6 Signature verification

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_import_public_key_args_t
- struct open_svc_sign_ver_args_t
- struct op_verify_sign_args_t

### Macros

- #define **HSM_OP_VERIFY_SIGN_FLAGS_INPUT_DIGEST** ((hsm_op_verify_sign_flags_t)(0u << 0))
- #define **HSM_OP_VERIFY_SIGN_FLAGS_INPUT_MESSAGE** ((hsm_op_verify_sign_flags_t)(1u << 0))
- #define HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT ((hsm_op_verify_sign_flags_t)(1u << 1))

  *when set the value passed by the key argument is considered as the internal*
- #define **HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL** ((hsm_op_verify_sign_flags_t)(1u << 2))
- #define **HSM_VERIFICATION_STATUS_SUCCESS** ((hsm_verification_status_t)(0x5A3CC3A5u))
- #define **HSM_VERIFICATION_STATUS_FAILURE** ((hsm_verification_status_t)(0x2B4DD4B2u))

### Typedefs

- typedef uint8_t **hsm_op_import_public_key_flags_t**
- typedef uint8_t **hsm_svc_signature_verification_flags_t**
- typedef uint32_t **hsm_verification_status_t**
- typedef uint8_t **hsm_op_verify_sign_flags_t**

### Functions

- hsm_err_t hsm_verify_sign (hsm_hdl_t session_hdl, op_verify_sign_args_t ∗args, hsm_verification_status_t ∗verification_status)
- hsm_err_t hsm_import_public_key (hsm_hdl_t signature_ver_hdl, op_import_public_key_args_t ∗args, uint32_t ∗key_ref)
- hsm_err_t hsm_close_signature_verification_service (hsm_hdl_t signature_ver_hdl)
- hsm_err_t hsm_open_signature_verification_service (hsm_hdl_t session_hdl, open_svc_sign_ver_args_t ∗args, hsm_hdl_t ∗signature_ver_hdl)
- hsm_err_t hsm_verify_signature (hsm_hdl_t signature_ver_hdl, op_verify_sign_args_t ∗args, hsm_verification_status_t ∗status)

### 5.6.1 Detailed Description

### 5.6.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| uint8_t ∗ | key | pointer to the public key to be imported |
| uint16_t | key_size | length in bytes of the input key |
| hsm_key_type_t | key_type | indicates the type of the key to be imported. |
| hsm_op_import_public_key_flags_t | flags | bitmap specifying the operation attributes |

#### 5.6.2.1 struct op_import_public_key_args_t

**Data Fields**

| | | |
|---|---|---|
| hsm_svc_signature_verification_flags_t | flags | < bitmap indicating the service flow properties |
| hsm_hdl_t | sig_ver_hdl | |

#### 5.6.2.2 struct open_svc_sign_ver_args_t

**Data Fields**

| | | |
|---|---|---|
| uint8_t ∗ | key | < pointer to the public key to be used for the verification. pointer to the input (message or message digest) |
| uint8_t ∗ | message | pointer to the input signature. The signature S=(r,s) is expected |
| uint8_t ∗ | signature | length in bytes of the input key |
| uint16_t | key_size | length in bytes of the output - it must contain one additional |
| uint16_t | signature_size | length in bytes of the input message |
| uint32_t | message_size | |
| hsm_verification_status_t | verification_status | identifier of the digital signature scheme to be used |
| hsm_signature_scheme_id_t | scheme_id | bitmap specifying the operation attributes |
| hsm_op_verify_sign_flags_t | flags | bitmap specifying the svc flow attributes |
| hsm_svc_signature_verification_flags_t | svc_flags | |

#### 5.6.2.3 struct op_verify_sign_args_t

### 5.6.3 Function Documentation

#### 5.6.3.1 hsm_verify_sign()

```
hsm_err_t hsm_verify_sign (
        hsm_hdl_t session_hdl,
        op_verify_sign_args_t ∗ args,
        hsm_verification_status_t ∗ verification_status )
```

Secondary API to verify a message signature.

This API does the following:

1. Open a flow for verification of the signature.

2. Based on the flag to identify the type of message: Digest or actual message, verification of the signature is done using the public key.

3. Post performing the operation, terminate the previously opened signature-verification service flow.
   User can call this function only after having opened a session.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the current key-store. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.6.3.2 hsm_import_public_key()

```
hsm_err_t hsm_import_public_key (
            hsm_hdl_t signature_ver_hdl,
            op_import_public_key_args_t * args,
            uint32_t * key_ref )
```

Import a public key to be used for several verification operations, a reference to the imported key is returned.
User can use the returned reference in the hsm_verify_signature API by setting the HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL flag
Only not-compressed keys (x,y) can be imported by this command. Compressed keys can be decompressed by using the dedicated API. User can call this function only after having opened a signature verification service flow.

**Parameters**

| | |
|---|---|
| *signature_ver_hdl* | handle identifying the signature verification service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *key_ref* | pointer to where the 4 bytes key reference to be used as key in the hsm_verify_signature will be stored |

**Returns**

error code

#### 5.6.3.3 hsm_close_signature_verification_service()

```
hsm_err_t hsm_close_signature_verification_service (
            hsm_hdl_t signature_ver_hdl )
```

Terminate a previously opened signature verification service flow

**Parameters**

| | |
|---|---|
| *signature_ver_hdl* | handle identifying the signature verification service flow to be closed. |

**Returns**

error code

### 5.6.3.4 hsm_open_signature_verification_service()

```
hsm_err_t hsm_open_signature_verification_↩
service (
            hsm_hdl_t session_hdl,
            open_svc_sign_ver_args_t * args,
            hsm_hdl_t * signature_ver_hdl )
```

User must open this service in order to perform signature verification operations. User can call this function only after having opened a session.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |
| *signature_ver_hdl* | pointer to where the signature verification service flow handle must be written. |

**Returns**

error code

### 5.6.3.5 hsm_verify_signature()

```
hsm_err_t hsm_verify_signature (
            hsm_hdl_t signature_ver_hdl,
            op_verify_sign_args_t * args,
            hsm_verification_status_t * status )
```

Verify a digital signature according to the signature scheme User can call this function only after having opened a signature verification service flow.

The signature S=(r,s) is expected to be in format r||s||Ry where:

- Ry is an additional byte containing the lsb of y. Ry will be considered as valid only, if the HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT is set.

Only not-compressed keys (x,y) can be used by this command. Compressed keys can be decompressed by using the dedicated API.

In case of HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3, message of op_verify_sign_args_t should be (as specified in GB/T 32918):

- equal to Z||M in case of HSM_OP_VERIFY_SIGN_FLAGS_INPUT_MESSAGE
- equal to SM3(Z||M) in case of HSM_OP_VERIFY_SIGN_FLAGS_INPUT_DIGEST

**Parameters**

| | |
|---|---|
| *signature_ver_hdl* | handle identifying the signature verification service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *status* | pointer to where the verification status must be stored if the verification succeed the value HSM_VERIFICATION_STATUS_SUCCESS is returned. |

**Returns**

error code

## 5.7 Random number generation

### Data Structures

- struct open_svc_rng_args_t
- struct op_get_random_args_t

### Typedefs

- typedef uint8_t **hsm_svc_rng_flags_t**

### Functions

- hsm_err_t hsm_do_rng (hsm_hdl_t session_hdl, op_get_random_args_t ∗args)
- hsm_err_t hsm_open_rng_service (hsm_hdl_t session_hdl, open_svc_rng_args_t ∗args, hsm_hdl_t ∗rng↩ _hdl)
- hsm_err_t hsm_close_rng_service (hsm_hdl_t rng_hdl)
- hsm_err_t hsm_get_random (hsm_hdl_t rng_hdl, op_get_random_args_t ∗args)

### 5.7.1 Detailed Description

### 5.7.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| hsm_svc_rng_flags_t | flags | < bitmap indicating the service flow properties |
| uint8_t | reserved[3] | |
| hsm_hdl_t | rng_hdl | |

#### 5.7.2.1 struct open_svc_rng_args_t

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | output | pointer to the output area where the random number must be written |
| uint32_t | random_size | length in bytes of the random number to be provided. bitmap indicating the service flow properties |
| hsm_svc_rng_flags_t | svc_flags | |
| uint8_t | reserved[3] | |

#### 5.7.2.2 struct op_get_random_args_t

### 5.7.3 Function Documentation

#### 5.7.3.1 hsm_do_rng()

```
hsm_err_t hsm_do_rng (
            hsm_hdl_t session_hdl,
            op_get_random_args_t * args )
```

Secondary API to fetch the Random Number
This API does the following:

1. Opens Random Number Generation Service Flow
2. Get a freshly generated random number
3. Terminate a previously opened rng service flow
   User can call this function only after having opened a session.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.7.3.2 hsm_open_rng_service()

```
hsm_err_t hsm_open_rng_service (
            hsm_hdl_t session_hdl,
            open_svc_rng_args_t * args,
            hsm_hdl_t * rng_hdl )
```

Open a random number generation service flow
User can call this function only after having opened a session.
User must open this service in order to perform rng operations.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |
| *rng_hdl* | pointer to where the rng service flow handle must be written. |

**Returns**

error code

#### 5.7.3.3 hsm_close_rng_service()

```
hsm_err_t hsm_close_rng_service (
            hsm_hdl_t rng_hdl )
```

Terminate a previously opened rng service flow

**Parameters**

| | |
|---|---|
| *rng_hdl* | handle identifying the rng service flow to be closed. |

**Returns**

error code

### 5.7.3.4 hsm_get_random()

```
hsm_err_t hsm_get_random (
        hsm_hdl_t rng_hdl,
        op_get_random_args_t * args )
```

Get a freshly generated random number
User can call this function only after having opened a rng service flow

**Parameters**

| | |
|---|---|
| *rng_hdl* | handle identifying the rng service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.8 Hashing

### Modules

- i.MX8QXP specificities

### Data Structures

- struct open_svc_hash_args_t
- struct op_hash_one_go_args_t

### Macros

- #define **HSM_HASH_ALGO_SHA_224** ((hsm_hash_algo_t)(0x0u))
- #define **HSM_HASH_ALGO_SHA_256** ((hsm_hash_algo_t)(0x1u))
- #define **HSM_HASH_ALGO_SHA_384** ((hsm_hash_algo_t)(0x2u))
- #define **HSM_HASH_ALGO_SHA_512** ((hsm_hash_algo_t)(0x3u))
- #define **HSM_HASH_ALGO_SM3_256** ((hsm_hash_algo_t)(0x11u))
- #define **HSM_HASH_FLAG_ALLOWED**

### Typedefs

- typedef uint8_t **hsm_hash_algo_t**

### Enumerations

- enum **hsm_hash_svc_flags_t** {
  **HSM_HASH_FLAG_ONE_SHOT** = 0x1,
  **HSM_HASH_FLAG_INIT** = 0x2,
  **HSM_HASH_FLAG_UPDATE** = 0x4,
  **HSM_HASH_FLAG_FINAL** = 0x8,
  **HSM_HASH_FLAG_GET_CONTEXT** = 0x80 }

### Functions

- hsm_err_t hsm_do_hash (hsm_hdl_t session_hdl, op_hash_one_go_args_t ∗args)
- hsm_err_t hsm_open_hash_service (hsm_hdl_t session_hdl, open_svc_hash_args_t ∗args, hsm_hdl_t ∗hash_hdl)
- hsm_err_t hsm_close_hash_service (hsm_hdl_t hash_hdl)
- hsm_err_t hsm_hash_one_go (hsm_hdl_t hash_hdl, op_hash_one_go_args_t ∗args)

### 5.8.1 Detailed Description

### 5.8.2 Data Structure Documentation

#### Data Fields

| | | |
|---|---|---|
| hsm_hdl_t | hash_hdl | |

#### 5.8.2.1 struct open_svc_hash_args_t

**Data Fields**

| | | |
|---|---|---|
| uint8_t ∗ | input | < pointer to the input data to be hashed pointer to the output area where the resulting digest must be written |
| uint8_t ∗ | output | length in bytes of the input |
| uint32_t | input_size | length in bytes of the output |
| uint32_t | output_size | hash algorithm to be used for the operation |
| hsm_hash_algo_t | algo | flags identifying the operation init() update(), final() or one shot |
| hsm_hash_svc_flags_t | svc_flags | |

#### 5.8.2.2 struct op_hash_one_go_args_t

### 5.8.3 Macro Definition Documentation

#### 5.8.3.1 HSM_HASH_FLAG_ALLOWED `#define HSM_HASH_FLAG_ALLOWED`

**Value:**

```
(HSM_HASH_FLAG_ONE_SHOT | HSM_HASH_FLAG_INIT \
| HSM_HASH_FLAG_UPDATE | HSM_HASH_FLAG_FINAL \
| HSM_HASH_FLAG_GET_CONTEXT)
```

### 5.8.4 Function Documentation

#### 5.8.4.1 hsm_do_hash()

```
hsm_err_t hsm_do_hash (
        hsm_hdl_t session_hdl,
        op_hash_one_go_args_t * args )
```

Secondary API to digest a message.
This API does the following:

1. Open an Hash Service Flow

2. Perform hash

3. Terminate a previously opened hash service flow
   User can call this function only after having opened a session.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.8.4.2 hsm_open_hash_service()

```
hsm_err_t hsm_open_hash_service (
        hsm_hdl_t session_hdl,
        open_svc_hash_args_t * args,
        hsm_hdl_t * hash_hdl )
```

Open an hash service flow
User can call this function only after having opened a session.
User must open this service in order to perform hash operations.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |
| *hash_hdl* | pointer to where the hash service flow handle must be written. |

**Returns**

error code

#### 5.8.4.3 hsm_close_hash_service()

```
hsm_err_t hsm_close_hash_service (
        hsm_hdl_t hash_hdl )
```

Terminate a previously opened hash service flow

**Parameters**

| | |
|---|---|
| *hash_hdl* | handle identifying the hash service flow to be closed. |

**Returns**

error code

#### 5.8.4.4 hsm_hash_one_go()

```
hsm_err_t hsm_hash_one_go (
        hsm_hdl_t hash_hdl,
        op_hash_one_go_args_t * args )
```

Perform the hash operation on a given input
User can call this function only after having opened a hash service flow

**Parameters**

| | |
|---|---|
| *hash_hdl* | handle identifying the hash service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.9 Public key reconstruction

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_pub_key_rec_args_t

### Typedefs

- typedef uint8_t **hsm_op_pub_key_rec_flags_t**

### Functions

- hsm_err_t hsm_pub_key_reconstruction (hsm_hdl_t session_hdl, op_pub_key_rec_args_t ∗args)

### 5.9.1 Detailed Description

### 5.9.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | pub_rec | pointer to the public reconstruction value extracted from the implicit certificate. |
| uint8_t ∗ | hash | pointer to the input hash value. In the butterfly scheme it corresponds to the hash value calculated over PCA certificate and, concatenated, the implicit certificat. |
| uint8_t ∗ | ca_key | pointer to the CA public key |
| uint8_t ∗ | out_key | pointer to the output area where the reconstructed public key must be written. |
| uint16_t | pub_rec_size | length in bytes of the public reconstruction value |
| uint16_t | hash_size | length in bytes of the input hash |
| uint16_t | ca_key_size | length in bytes of the input CA public key |
| uint16_t | out_key_size | length in bytes of the output key |
| hsm_key_type_t | key_type | indicates the type of the managed key. |
| hsm_op_pub_key_rec_flags_t | flags | flags bitmap specifying the operation attributes. |
| uint16_t | reserved | |

#### 5.9.2.1 struct op_pub_key_rec_args_t

### 5.9.3 Function Documentation

#### 5.9.3.1 hsm_pub_key_reconstruction()

```
hsm_err_t hsm_pub_key_reconstruction (
        hsm_hdl_t session_hdl,
        op_pub_key_rec_args_t * args )
```

Reconstruct an ECC public key provided by an implicit certificate
User can call this function only after having opened a session
This API implements the followign formula:
out_key = (pub_rec $*$ hash) + ca_key

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.10 Public key decompression

### Modules

- i.MX8QXP specificities

### Data Structures

- struct op_pub_key_dec_args_t

### Typedefs

- typedef uint8_t **hsm_op_pub_key_dec_flags_t**

### Functions

- hsm_err_t hsm_pub_key_decompression (hsm_hdl_t session_hdl, op_pub_key_dec_args_t ∗args)

### 5.10.1 Detailed Description

### 5.10.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | key | pointer to the compressed ECC public key. The expected key format is x\|\|lsb_y where lsb_y is 1 byte having value 1 if the least-significant bit of the original (uncompressed) y coordinate is set, and 0 otherwise. |
| uint8_t ∗ | out_key | pointer to the output area where the decompressed public key must be written. |
| uint16_t | key_size | length in bytes of the input compressed public key |
| uint16_t | out_key_size | length in bytes of the resulting public key |
| hsm_key_type_t | key_type | indicates the type of the manged keys. |
| hsm_op_pub_key_dec_flags_t | flags | bitmap specifying the operation attributes. |
| uint16_t | reserved | |

#### 5.10.2.1 struct op_pub_key_dec_args_t

### 5.10.3 Function Documentation

#### 5.10.3.1 hsm_pub_key_decompression()

```
hsm_err_t hsm_pub_key_decompression (
        hsm_hdl_t session_hdl,
        op_pub_key_dec_args_t * args )
```

Decompress an ECC public key
The expected key format is x||lsb_y where lsb_y is 1 byte having value 1 if the least-significant bit of the original (uncompressed) y coordinate is set, and 0 otherwise.
User can call this function only after having opened a session

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.11 ECIES encryption

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_ecies_enc_args_t

### Typedefs

- typedef uint8_t **hsm_op_ecies_enc_flags_t**

### Functions

- hsm_err_t hsm_ecies_encryption (hsm_hdl_t session_hdl, op_ecies_enc_args_t ∗args)

### 5.11.1 Detailed Description

### 5.11.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | input | pointer to the input plaintext |
| uint8_t ∗ | pub_key | pointer to the input recipient public key |
| uint8_t ∗ | p1 | pointer to the KDF P1 input parameter |
| uint8_t ∗ | p2 | pointer to the MAC P2 input parameter should be NULL |
| uint8_t ∗ | output | pointer to the output area where the VCT must be written |
| uint32_t | input_size | length in bytes of the input plaintext should be equal to 16 bytes |
| uint16_t | p1_size | length in bytes of the KDF P1 parameter should be equal to 32 bytes |
| uint16_t | p2_size | length in bytes of the MAC P2 parameter should be zero reserved for generic use cases |
| uint16_t | pub_key_size | length in bytes of the recipient public key should be equal to 64 bytes |
| uint16_t | mac_size | length in bytes of the requested message authentication code should be equal to 16 bytes |
| uint32_t | out_size | length in bytes of the output VCT should be equal to 96 bytes |
| hsm_key_type_t | key_type | indicates the type of the recipient public key |
| hsm_op_ecies_enc_flags_t | flags | bitmap specifying the operation attributes. |
| uint16_t | reserved | |

#### 5.11.2.1 struct op_ecies_enc_args_t

### 5.11.3 Function Documentation

#### 5.11.3.1 hsm_ecies_encryption()

```
hsm_err_t hsm_ecies_encryption (
        hsm_hdl_t session_hdl,
        op_ecies_enc_args_t * args )
```

Encrypt data usign ECIES
User can call this function only after having opened a session.
ECIES is supported with the constraints specified in 1609.2-2016.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.12 Data storage

### Data Structures

- struct open_svc_data_storage_args_t
- struct op_data_storage_args_t

### Macros

- #define HSM_OP_DATA_STORAGE_FLAGS_STORE ((hsm_op_data_storage_flags_t)(1u << 0))

    *Store data.*
- #define HSM_OP_DATA_STORAGE_FLAGS_RETRIEVE ((hsm_op_data_storage_flags_t)(0u << 0))

    *Retrieve data.*

### Typedefs

- typedef uint8_t **hsm_svc_data_storage_flags_t**
- typedef uint8_t **hsm_op_data_storage_flags_t**

### Functions

- hsm_err_t hsm_data_ops (hsm_hdl_t key_store_hdl, op_data_storage_args_t ∗args)
- hsm_err_t hsm_open_data_storage_service (hsm_hdl_t key_store_hdl, open_svc_data_storage_args_t ∗args, hsm_hdl_t ∗data_storage_hdl)
- hsm_err_t hsm_data_storage (hsm_hdl_t data_storage_hdl, op_data_storage_args_t ∗args)
- hsm_err_t hsm_close_data_storage_service (hsm_hdl_t data_storage_hdl)

### 5.12.1 Detailed Description

### 5.12.2 Data Structure Documentation

#### Data Fields

| | | |
|---:|---|---|
| hsm_hdl_t | data_storage_handle | |
| hsm_svc_data_storage_flags_t | flags | bitmap specifying the services properties. |
| uint8_t | reserved[3] | |

#### 5.12.2.1 struct open_svc_data_storage_args_t

#### Data Fields

| | | |
|---:|---|---|
| uint8_t ∗ | data | < pointer to the data. In case of store request, length in bytes of the data |
| uint32_t | data_size | id of the data |
| uint16_t | data_id | bitmap specifying the services properties. |
| hsm_svc_data_storage_flags_t | flags | flags bitmap specifying the operation attributes. |
| hsm_op_data_storage_flags_t | svc_flags | |

#### 5.12.2.2 struct op_data_storage_args_t

### 5.12.3 Function Documentation

#### 5.12.3.1 hsm_data_ops()

```
hsm_err_t hsm_data_ops (
        hsm_hdl_t key_store_hdl,
        op_data_storage_args_t * args )
```

Secondary API to store and restoare data from the linux
filesystem managed by EdgeLock Enclave Firmware.

This API does the following:

1. Open an data storage service Flow
2. Based on the flag for operation attribute: Store or Re-store,
    - Store the data
    - Re-store the data, from the non-volatile storage.
3. Post performing the operation, terminate the previously opened data-storage service flow.
   User can call this function only after having opened a key-store.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the current key-store. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.12.3.2 hsm_open_data_storage_service()

```
hsm_err_t hsm_open_data_storage_service (
        hsm_hdl_t key_store_hdl,
        open_svc_data_storage_args_t * args,
        hsm_hdl_t * data_storage_hdl )
```

Open a data storage service flow
User must open this service flow in order to store/retrieve generic data in/from the HSM.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *data_storage_hdl* | pointer to where the data storage service flow handle must be written. |

**Returns**

error_code error code.

#### 5.12.3.3 hsm_data_storage()

```
hsm_err_t hsm_data_storage (
            hsm_hdl_t data_storage_hdl,
            op_data_storage_args_t * args )
```

Store or retrieve generic data identified by a data_id.

**Parameters**

| | |
|---|---|
| *data_storage_hdl* | handle identifying the data storage service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.12.3.4 hsm_close_data_storage_service()

```
hsm_err_t hsm_close_data_storage_service (
            hsm_hdl_t data_storage_hdl )
```

Terminate a previously opened data storage service flow

**Parameters**

| | |
|---|---|
| *data_storage_hdl* | handle identifying the data storage service flow. |

**Returns**

error code

## 5.13 Root KEK export

### Data Structures

- struct op_export_root_kek_args_t

### Macros

- #define **HSM_OP_EXPORT_ROOT_KEK_FLAGS_COMMON_KEK** ((hsm_op_export_root_kek_flags_↩ t)(1u << 0))
- #define **HSM_OP_EXPORT_ROOT_KEK_FLAGS_UNIQUE_KEK** ((hsm_op_export_root_kek_flags_t)(0u << 0))

### Typedefs

- typedef uint8_t **hsm_op_export_root_kek_flags_t**

### Functions

- hsm_err_t hsm_export_root_key_encryption_key (hsm_hdl_t session_hdl, op_export_root_kek_args_t ∗args)

### 5.13.1 Detailed Description

### 5.13.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | signed_message | pointer to signed_message authorizing the operation |
| uint8_t ∗ | out_root_kek | pointer to the output area where the derived root kek (key encryption key) must be written |
| uint16_t | signed_msg_size | size of the signed_message authorizing the operation |
| uint8_t | root_kek_size | length in bytes of the root kek. Must be 32 bytes. |
| hsm_op_export_root_kek_flags_t | flags | flags bitmap specifying the operation attributes. |
| uint8_t | reserved[2] | |

#### 5.13.2.1 struct op_export_root_kek_args_t

### 5.13.3 Function Documentation

#### 5.13.3.1 hsm_export_root_key_encryption_key()

```
hsm_err_t hsm_export_root_key_encryption_key (
        hsm_hdl_t session_hdl,
        op_export_root_kek_args_t ∗ args )
```

Export the root key encryption key. This key is derived on chip. It can be common or chip unique. This key will be used to import key in the key store through the manage key API.

#### Parameters

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

#### Returns

error code

## 5.14 Authenticated Encryption

### Functions

- hsm_err_t hsm_do_auth_enc (hsm_hdl_t key_store_hdl, op_auth_enc_args_t ∗auth_enc_args)

### 5.14.1 Detailed Description

### 5.14.2 Function Documentation

#### 5.14.2.1 hsm_do_auth_enc()

```
hsm_err_t hsm_do_auth_enc (
            hsm_hdl_t key_store_hdl,
            op_auth_enc_args_t * auth_enc_args )
```

Secondary API to perform Authenticated Encryption
This API does the following:

1. Opens Cipher Service Flow
2. Perform Authenticated Encryption operation
3. Terminates the previously opened Cipher service flow
   User can call this function only after having opened a key store service flow.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.15 Mac

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct open_svc_mac_args_t
- struct op_mac_one_go_args_t

### Macros

- #define **HSM_OP_MAC_ONE_GO_FLAGS_MAC_VERIFICATION** ((hsm_op_mac_one_go_flags_t)(0u << 0))
- #define **HSM_OP_MAC_ONE_GO_FLAGS_MAC_GENERATION** ((hsm_op_mac_one_go_flags_t)(1u << 0))
- #define **HSM_OP_MAC_ONE_GO_FLAGS_MAC_LENGTH_IN_BITS** ((hsm_op_mac_one_go_flags_t)(1u << 1))
- #define **HSM_OP_MAC_ONE_GO_ALGO_AES_CMAC** ((hsm_op_mac_one_go_algo_t)(0x01u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_224** ((hsm_op_mac_one_go_algo_t)(0x05u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_256** ((hsm_op_mac_one_go_algo_t)(0x06u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_384** ((hsm_op_mac_one_go_algo_t)(0x07u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_512** ((hsm_op_mac_one_go_algo_t)(0x08u))
- #define **HSM_MAC_VERIFICATION_STATUS_SUCCESS** ((hsm_mac_verification_status_t)(0x6C1AA1C6u))

### Typedefs

- typedef uint8_t **hsm_svc_mac_flags_t**
- typedef uint8_t **hsm_op_mac_one_go_flags_t**
- typedef uint32_t **hsm_mac_verification_status_t**
- typedef uint8_t **hsm_op_mac_one_go_algo_t**

### Functions

- hsm_err_t hsm_do_mac (hsm_hdl_t key_store_hdl, op_mac_one_go_args_t *mac_one_go)
- hsm_err_t hsm_open_mac_service (hsm_hdl_t key_store_hdl, open_svc_mac_args_t *args, hsm_hdl_t *mac_hdl)
- hsm_err_t hsm_mac_one_go (hsm_hdl_t mac_hdl, op_mac_one_go_args_t *args, hsm_mac_verification_status_t *status)
- hsm_err_t hsm_close_mac_service (hsm_hdl_t mac_hdl)

### 5.15.1 Detailed Description

### 5.15.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| hsm_svc_mac_flags_t | flags | < bitmap specifying the services properties. |
| hsm_hdl_t | mac_serv_hdl | |

#### 5.15.2.1 struct open_svc_mac_args_t

**Data Fields**

| | | |
|---|---|---|
| uint32_t | key_identifier | < identifier of the key to be used for the operation algorithm to be used for the operation |
| hsm_op_mac_one_go_algo_t | algorithm | bitmap specifying the operation attributes |
| hsm_op_mac_one_go_flags_t | flags | pointer to the payload area |
| uint8_t * | payload | pointer to the tag area |
| uint8_t * | mac | length in bytes of the payload |
| uint32_t | payload_size | length of the tag. |
| uint16_t | mac_size | expected mac size for output, returned by FW in case the mac size |
| uint16_t | expected_mac_size | |
| hsm_mac_verification_status_t | verification_status | bitmap specifying the services properties. |
| hsm_svc_mac_flags_t | svc_flags | |

#### 5.15.2.2 struct op_mac_one_go_args_t

### 5.15.3 Function Documentation

#### 5.15.3.1 hsm_do_mac()

```
hsm_err_t hsm_do_mac (
        hsm_hdl_t key_store_hdl,
        op_mac_one_go_args_t * mac_one_go )
```

Secondary API to perform mac operation
This API does the following:

1. Open an MAC Service Flow
2. Perform mac operation
3. Terminate a previously opened mac service flow
   User can call this function only after having opened a key store service flow.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.15.3.2 hsm_open_mac_service()

```
hsm_err_t hsm_open_mac_service (
        hsm_hdl_t key_store_hdl,
        open_svc_mac_args_t * args,
        hsm_hdl_t * mac_hdl )
```

Open a mac service flow

User can call this function only after having opened a key store service flow.
User must open this service in order to perform mac operation

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the key store service flow. |
| *args* | pointer to the structure containing the function arguments. |
| *mac_hdl* | pointer to where the mac service flow handle must be written. |

**Returns**

error code

#### 5.15.3.3 hsm_mac_one_go()

```
hsm_err_t hsm_mac_one_go (
        hsm_hdl_t mac_hdl,
        op_mac_one_go_args_t * args,
        hsm_mac_verification_status_t * status )
```

Perform mac operation
User can call this function only after having opened a mac service flow
For CMAC algorithm, a key of type HSM_KEY_TYPE_AES_XXX must be used
For HMAC algorithm, a key of type HSM_KEY_TYPE_HMAC_XXX must be used
For mac verification operations, the verified mac length can be specified in:

- Bits by setting the HSM_OP_MAC_ONE_GO_FLAGS_MAC_LENGTH_IN_BITS flag,
- if this flag is clear then the mac_length is specified in bytes.

For mac generation operations:

- mac length must be set in bytes, and
- HSM_OP_MAC_ONE_GO_FLAGS_MAC_LENGTH_IN_BITS flag must be 0

**Parameters**

| | |
|---|---|
| *mac_hdl* | handle identifying the mac service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

### 5.15.3.4 hsm_close_mac_service()

```
hsm_err_t hsm_close_mac_service (
        hsm_hdl_t mac_hdl )
```

Terminate a previously opened mac service flow

**Parameters**

| | |
|---|---|
| *mac_hdl* | pointer to handle identifying the mac service flow to be closed. |

**Returns**

error code

## 5.16 SM2 Get Z

### Modules

- i.MX8QXP specificities

### Data Structures

- struct op_sm2_get_z_args_t

### Typedefs

- typedef uint8_t **hsm_op_sm2_get_z_flags_t**

### Functions

- hsm_err_t hsm_sm2_get_z (hsm_hdl_t session_hdl, op_sm2_get_z_args_t ∗args)

### 5.16.1 Detailed Description

### 5.16.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | public_key | pointer to the sender public key |
| uint8_t ∗ | identifier | pointer to the sender identifier |
| uint8_t ∗ | z_value | pointer to the output area where the Z value must be written |
| uint16_t | public_key_size | length in bytes of the sender public key should be equal to 64 bytes |
| uint8_t | id_size | length in bytes of the identifier |
| uint8_t | z_size | length in bytes of Z should be at least 32 bytes |
| hsm_key_type_t | key_type | indicates the type of the sender public key. Only HSM_KEY_TYPE_DSA_SM2_FP_256 is supported. |
| hsm_op_sm2_get_z_flags_t | flags | bitmap specifying the operation attributes. |
| uint8_t | reserved[2] | |

#### 5.16.2.1 struct op_sm2_get_z_args_t

### 5.16.3 Function Documentation

#### 5.16.3.1 hsm_sm2_get_z()

```
hsm_err_t hsm_sm2_get_z (
        hsm_hdl_t session_hdl,
        op_sm2_get_z_args_t ∗ args )
```

This command is designed to compute Z = SM3(Entl || ID || a || b || xG || yG || xpubk || ypubk)

- ID, Entl: user distinguishing identifier and length,
- a, b, xG and yG : curve parameters,
- xpubk , ypubk : public key

  This value is used for SM2 public key cryptography algorithms, as specified in GB/T 32918. User can call this function only after having opened a session.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.17 SM2 ECES decryption

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct open_svc_sm2_eces_args_t
- struct op_sm2_eces_dec_args_t

### Typedefs

- typedef uint8_t **hsm_svc_sm2_eces_flags_t**
- typedef uint8_t **hsm_op_sm2_eces_dec_flags_t**

### Functions

- hsm_err_t hsm_open_sm2_eces_service (hsm_hdl_t key_store_hdl, open_svc_sm2_eces_args_t ∗args, hsm_hdl_t ∗sm2_eces_hdl)
- hsm_err_t hsm_close_sm2_eces_service (hsm_hdl_t sm2_eces_hdl)
- hsm_err_t hsm_sm2_eces_decryption (hsm_hdl_t sm2_eces_hdl, op_sm2_eces_dec_args_t ∗args)

### 5.17.1 Detailed Description

### 5.17.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| hsm_svc_sm2_eces_flags_t | flags | bitmap indicating the service flow properties |
| uint8_t | reserved[3] | |

#### 5.17.2.1 struct open_svc_sm2_eces_args_t

Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | identifier of the private key to be used for the operation |
| uint8_t ∗ | input | pointer to the input ciphertext |
| uint8_t ∗ | output | pointer to the output area where the plaintext must be written |
| uint32_t | input_size | length in bytes of the input ciphertext. |
| uint32_t | output_size | length in bytes of the output plaintext |
| hsm_key_type_t | key_type | indicates the type of the used key. Only HSM_KEY_TYPE_DSA_SM2_FP_256 is supported. |
| hsm_op_sm2_eces_dec_flags_t | flags | bitmap specifying the operation attributes. |
| uint16_t | reserved | |

#### 5.17.2.2 struct op_sm2_eces_dec_args_t

### 5.17.3 Function Documentation

#### 5.17.3.1 hsm_open_sm2_eces_service()

```
hsm_err_t hsm_open_sm2_eces_service (
        hsm_hdl_t key_store_hdl,
        open_svc_sm2_eces_args_t * args,
        hsm_hdl_t * sm2_eces_hdl )
```

Open a SM2 ECES decryption service flow
User can call this function only after having opened a key store.
User must open this service in order to perform SM2 decryption.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |
| *sm2_eces_hdl* | pointer to where the sm2 eces service flow handle must be written. |

**Returns**

error code

#### 5.17.3.2 hsm_close_sm2_eces_service()

```
hsm_err_t hsm_close_sm2_eces_service (
        hsm_hdl_t sm2_eces_hdl )
```

Terminate a previously opened SM2 ECES service flow

**Parameters**

| | |
|---|---|
| *sm2_eces_hdl* | handle identifying the SM2 ECES service flow to be closed. |

**Returns**

error code

#### 5.17.3.3 hsm_sm2_eces_decryption()

```
hsm_err_t hsm_sm2_eces_decryption (
        hsm_hdl_t sm2_eces_hdl,
        op_sm2_eces_dec_args_t * args )
```

Decrypt data usign SM2 ECES
User can call this function only after having opened a SM2 ECES service flow.
SM2 ECES is supported with the requirements specified in the GB/T 32918.4.

**Parameters**

| | |
|---|---|
| *sm2_eces_hdl* | handle identifying the SM2 ECES |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.18 SM2 ECES encryption

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_sm2_eces_enc_args_t

### Typedefs

- typedef uint8_t **hsm_op_sm2_eces_enc_flags_t**

### Functions

- hsm_err_t hsm_sm2_eces_encryption (hsm_hdl_t session_hdl, op_sm2_eces_enc_args_t ∗args)

### 5.18.1 Detailed Description

### 5.18.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | input | pointer to the input plaintext |
| uint8_t ∗ | output | pointer to the output area where the ciphertext must be written |
| uint8_t ∗ | pub_key | pointer to the input recipient public key |
| uint32_t | input_size | length in bytes of the input plaintext |
| uint32_t | output_size | length in bytes of the output ciphertext.<br>It should be at least input_size + 97 bytes (overhead related to C1 and C3 - as specifed below) + size alignment constraints specific to a given implementation (see related chapter). |
| uint16_t | pub_key_size | length in bytes of the recipient public key should be equal to 64 bytes |
| hsm_key_type_t | key_type | indicates the type of the recipient public key. Only HSM_KEY_TYPE_DSA_SM2_FP_256 is supported. |
| hsm_op_sm2_eces_enc_flags_t | flags | bitmap specifying the operation attributes. |

#### 5.18.2.1 struct op_sm2_eces_enc_args_t

### 5.18.3 Function Documentation

#### 5.18.3.1 hsm_sm2_eces_encryption()

```
hsm_err_t hsm_sm2_eces_encryption (
        hsm_hdl_t session_hdl,
        op_sm2_eces_enc_args_t * args )
```

Encrypt data usign SM2 ECES
User can call this function only after having opened a session.
SM2 ECES is supported with the requirements specified in the GB/T 32918.4.
The output (i.e. ciphertext) is stored in the format C= C1||C2||C3 :
C1 = PC||x1||y1 where PC=04 and (x1,y1) are the coordinates of a an elliptic curve point
C2 = M xor t where t=KDF(x2||y2, input_size) and (x2,y2) are the coordinates of a an elliptic curve point
C3 = SM3 (x2||M||y2)

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.19 Key exchange

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_key_exchange_args_t
- struct op_tls_finish_args_t

### Macros

- #define **HSM_KDF_ALG_FOR_SM2** ((hsm_kdf_algo_id_t)0x10u)
- #define HSM_KDF_HMAC_SHA_256_TLS_0_16_4 ((hsm_kdf_algo_id_t)0x20u)

  *TLS PRF based on HMAC with SHA-256, the resulting mac_key_length is 0 bytes, enc_key_length is 16 bytes and fixed_iv_length is 4 bytes.*
- #define HSM_KDF_HMAC_SHA_384_TLS_0_32_4 ((hsm_kdf_algo_id_t)0x21u)

  *TLS PRF based on HMAC with SHA-384, the resulting mac_key_length is 0 bytes, enc_key_length is 32 bytes and fixed_iv_length is 4 bytes.*
- #define HSM_KDF_HMAC_SHA_256_TLS_0_32_4 ((hsm_kdf_algo_id_t)0x22u)

  *TLS PRF based on HMAC with SHA-256, the resulting mac_key_length is 0 bytes, enc_key_length is 32 bytes and fixed_iv_length is 4 bytes.*
- #define HSM_KDF_HMAC_SHA_256_TLS_32_16_4 ((hsm_kdf_algo_id_t)0x23u)

  *TLS PRF based on HMAC with SHA-256, the resulting mac_key_length is 32 bytes, enc_key_length is 16 bytes and fixed_iv_length is 4 bytes.*
- #define HSM_KDF_HMAC_SHA_384_TLS_48_32_4 ((hsm_kdf_algo_id_t)0x24u)

  *TLS PRF based on HMAC with SHA-384, the resulting mac_key_length is 48 bytes, enc_key_length is 32 bytes and fixed_iv_length is 4 bytes.*
- #define HSM_KDF_ONE_STEP_SHA_256 ((hsm_kdf_algo_id_t)0x31u)

  *One-Step Key Derivation using SHA256 as per NIST SP80056C. It can only be used, together with a signed message, to generate KEKs (key encryption keys) for key injection (hsm_manage_key API).*
- #define **HSM_KE_SCHEME_ECDH_NIST_P256** ((hsm_key_exchange_scheme_id_t)0x02u)
- #define **HSM_KE_SCHEME_ECDH_NIST_P384** ((hsm_key_exchange_scheme_id_t)0x03u)
- #define **HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_256** ((hsm_key_exchange_scheme_id_t)0x13u)
- #define **HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_384** ((hsm_key_exchange_scheme_id_t)0x15u)
- #define **HSM_KE_SCHEME_ECDH_BRAINPOOL_T1_256** ((hsm_key_exchange_scheme_id_t)0x23u)
- #define **HSM_KE_SCHEME_SM2_FP_256** ((hsm_key_exchange_scheme_id_t)0x42u)
- #define HSM_OP_KEY_EXCHANGE_FLAGS_UPDATE ((hsm_op_key_exchange_flags_t)(1u << 0))

  *User can replace an existing key only by the derived key which should have the same type of the original one.*
- #define HSM_OP_KEY_EXCHANGE_FLAGS_CREATE ((hsm_op_key_exchange_flags_t)(1u << 1))

  *Create a new key.*
- #define HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL ((hsm_op_key_exchange_flags_t)(1u << 2))

  *Use an ephemeral key (freshly generated key)*
- #define HSM_OP_KEY_EXCHANGE_FLAGS_KEY_CONF_EN ((hsm_op_key_exchange_flags_t)(1u << 3))

  *Enable key confirmation (valid only in case of HSM_KE_SCHEME_SM2_FP_256)*
- #define HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS ((hsm_op_key_exchange_flags_t)(1u << 4))

  *Use extended master secret for TLS KDFs.*

- #define HSM_OP_KEY_EXCHANGE_FLAGS_STRICT_OPERATION ((hsm_op_key_exchange_flags_t)(1u << 7))

  *The request is completed only when the new key has been written in the NVM. This applicable for persistent key only.*
- #define **HSM_OP_TLS_FINISH_HASH_ALGO_SHA256** (0x06)
- #define **HSM_OP_TLS_FINISH_HASH_ALGO_SHA384** (0x07)
- #define HSM_OP_TLS_FINISH_FLAGS_CLIENT (1 << 0)

  *Use "client finished" label for PRF.*
- #define HSM_OP_TLS_FINISH_FLAGS_SERVER (1 << 1)

  *Use "server finished" label for PRF.*

## Typedefs

- typedef uint8_t **hsm_kdf_algo_id_t**
- typedef uint8_t **hsm_key_exchange_scheme_id_t**
- typedef uint8_t **hsm_op_key_exchange_flags_t**
- typedef uint8_t **hsm_op_tls_finish_algo_id_t**
- typedef uint8_t **hsm_op_tls_finish_flags_t**

## Functions

- hsm_err_t hsm_key_exchange (hsm_hdl_t key_management_hdl, op_key_exchange_args_t *args)
- hsm_err_t hsm_tls_finish (hsm_hdl_t key_management_hdl, op_tls_finish_args_t *args)

### 5.19.1 Detailed Description

### 5.19.2 Data Structure Documentation

#### Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | identifier of the key used for derivation. It must be zero, if HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL is set. |
| uint8_t * | shared_key_identifier_array | pointer to the identifiers of the derived keys. In case of create operation the new destination key identifiers will be stored in this location. In case of update operation the destination key identifiers to update are provided by the caller in this location. |
| uint8_t * | ke_input | pointer to the initiator input data related to the key exchange function. |
| uint8_t * | ke_output | pointer to the output area where the data related to the key exchange function must be written. It corresponds to the receiver public data. |
| uint8_t * | kdf_input | pointer to the input data of the KDF. |

**Data Fields**

| | | |
|---|---|---|
| uint8_t ∗ | kdf_output | pointer to the output area where the non sensitive output data related to the KDF are written. |
| hsm_key_group_t | shared_key_group | It specifies the group where the derived keys will be stored.<br>It must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API. |
| hsm_key_info_t | shared_key_info | bitmap specifying the properties of the derived keys, it will be applied to all the derived keys. |
| hsm_key_type_t | shared_key_type | indicates the type of the derived key. |
| hsm_key_type_t | initiator_public_data_type | indicates the public data type specified by the initiator, e.g. public key type. |
| hsm_key_exchange_scheme_id_t | key_exchange_scheme | indicates the key exchange scheme |
| hsm_kdf_algo_id_t | kdf_algorithm | indicates the KDF algorithm |
| uint16_t | ke_input_size | length in bytes of the input data of the key exchange function. |
| uint16_t | ke_output_size | length in bytes of the output data of the key exchange function |
| uint8_t | shared_key_identifier_array_size | length in byte of the area containing the shared key identifiers |
| uint8_t | kdf_input_size | length in bytes of the input data of the KDF. |
| uint8_t | kdf_output_size | length in bytes of the non sensitive output data related to the KDF. |
| hsm_op_key_exchange_flags_t | flags | bitmap specifying the operation properties |
| uint8_t ∗ | signed_message | pointer to the signed_message authorizing the operation. |
| uint16_t | signed_msg_size | size of the signed_message authorizing the operation. |
| uint8_t | reserved[2] | It must be 0. |

### 5.19.2.1 struct op_key_exchange_args_t

**Data Fields**

| | | |
|---|---|---|
| uint32_t | key_identifier | identifier of the master_secret key used for the PRF. |
| uint8_t ∗ | handshake_hash_input | pointer to the input area containing the hash of the handshake messages. |
| uint8_t ∗ | verify_data_output | pointer to the output area where the verify_data contents will be written. |
| uint16_t | handshake_hash_input_size | size of the hash of the handshake messages |

Data Fields

| | | |
|---|---|---|
| uint16_t | verify_data_output_size | size of the required verify_data output |
| hsm_op_tls_finish_flags_t | flags | bitmap specifying the operation properties |
| hsm_op_tls_finish_algo_id_t | hash_algorithm | hash algorithm to be used for the PRF |
| uint8_t | reserved[2] | It must be 0. |

#### 5.19.2.2 struct op_tls_finish_args_t

### 5.19.3 Function Documentation

#### 5.19.3.1 hsm_key_exchange()

```
hsm_err_t hsm_key_exchange (
        hsm_hdl_t key_management_hdl,
        op_key_exchange_args_t * args )
```

This command is designed to compute secret keys through a key exchange protocol and the use of a key derivation function. The resulting secret keys are stored into the key store as new keys or as an update of existing keys.
A freshly generated key or an existing key can be used as input of the shared secret calculation.
User can call this function only after having opened a key management service flow.

This API support three use cases:

- Key Encryption Key generation:
  - shared_key_identifier_array: it must corresponds to the KEK key id.
  - The kdf_input must be 0
  - The kdf_output must be 0
  - The shared_key_info must have the HSM_KEY_INFO_KEK bit set (only Key Encryption Keys can be generated).
  - The shared_key_type must be HSM_KEY_TYPE_AES_256
  - The initiator_public_data_type must be HSM_KEY_TYPE_ECDSA_NIST_P256 or HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 or HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_256.
  - The key_exchange_scheme must be HSM_KE_SCHEME_ECDH_NIST_P256 or HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_256 or HSM_KE_SCHEME_ECDH_BRAINPOOL_T1_256.
  - The kdf_algorithm must be HSM_KDF_ONE_STEP_SHA_256. As per as per SP800-56C rev2, the KEK is generated using the formula SHA_256(counter || Z || FixedInput), where:
    - counter is the value 1 expressed in 32 bit and in big endian format
    - Z is the shared secret generated by the DH key-establishment scheme
    - FixedInput is the literal 'NXP HSM USER KEY DERIVATION' (27 bytes, no null termination).
  - The kdf_input_size must be 0.
  - The kdf_output_size must be 0.
  - Flags: the use of the HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL flag is mandatory (only freshly generated keys can be used as input of the Z derivation)
  - signed_message: mandatory in OEM CLOSED life cycle.
- TLS Key generation:

  - Only an ephemeral key pair is supported as input of the TLS key_exchange negotiation. This can be:
    - either a TRANSIENT private key already stored into the key store indicated by its key identifier. To prevent any misuse non-transient key will be rejected, additionally the private key will be deleted from the key store as part of this command handling.
    - either a key pair freshly generated by the use of HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL flag.
  - shared_key_identifier_array: it must correspond to the concatenation of client_write_MAC_key id (4 bytes, if any), server_write_MAC_key id (4 bytes, if any), client_write_key id (4 bytes), the server_write_key id (4 bytes), and the master_secret key id (4 bytes).
  - The kdf_input format depends on the HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS flag:
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS not set, the kdf_input must correspond to the concatenation of clientHello_random (32 bytes), serverHello_random (32 bytes), server_random (32 bytes) and client_random (32 bytes).
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS set, the kdf_input must correspond to the concatentation of message_hash, server_random (32 bytes) and client_random (32 bytes). The length of the message_hash must be 32 bytes for SHA256 based KDFs or 48 bytes for SHA384 based KDFs.
  - kdf_output: the concatenation of client_write_iv (4 bytes) and server_write_iv (4 bytes) will be stored at this address.
  - The shared_key_info must have the HSM_KEY_INFO_TRANSIENT bit set (only transient keys can be generated), the HSM_KEY_INFO_KEK bit is not allowed.
  - The shared_key_type is not applicable and must be left to 0.
  - The initiator_public_data_type must be HSM_KEY_TYPE_ECDSA_NIST_P256/384 or HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256/384.
  - The key_exchange_scheme must be HSM_KE_SCHEME_ECDH_NIST_P256/384 or HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_256/384.
  - The kdf_algorithm must be HSM_KDF_HMAC_SHA_xxx_TLS_xxx. The generated MAC keys will have type ALG_HMAC_XXX, where XXX corresponds to the key length in bit of generated MAC key. The generated encryption keys will have type HSM_KEY_TYPE_AES_XXX, where XXX corresponds to the key length in bit of the generated AES key. The master_secret key can only be used for the hsm_tls_finish function or be deleted using the hsm_manage_key function.
  - kdf_input_size:
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS not set, it must be 128 bytes.
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS set, it must be 96 (SHA256) or 112 (SHA384) bytes.
  - kdf_output_size: It must be 8 bytes
  - signed_message: it must be NULL

- SM2 key generation (as specified in GB/T 32918):
  - Only the receiver role is supported.
  - ke_input = (x||y) || (xephemeral||yephemeral) of the 2 public keys of initiator
  - ke_out = (x||y)|| (xephemeral||yephemeral) of the 2 public keys the receiver
  - kdf_input = (Zinitiator||Zinitiator||V1) if HSM_OP_KEY_EXCHANGE_FLAGS_KEY_CONF_EN enabled,
    where V1 is the verification value calculated on the initiator side
  - kdf_output = (VA||VB) if HSM_OP_KEY_EXCHANGE_FLAGS_KEY_CONF_EN enabled, 0 otherwise.
  - shared_key_info: the HSM_KEY_INFO_KEK bit is not allowed.
  - The shared_key_type must be HSM_KEY_TYPE_SM4_128 or HSM_KEY_TYPE_DSA_SM2_FP_256
  - The initiator_public_data_type must be HSM_KEY_TYPE_DSA_SM2_FP_256
  - The key_exchange_scheme must be HSM_KE_SCHEME_SM2_FP_256.
  - The kdf_algorithm must be HSM_KDF_ALG_FOR_SM2.
  - Flags: the HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL flag is not supported
  - signed_message: it must be NULL

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key store management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

#### 5.19.3.2 hsm_tls_finish()

```
hsm_err_t hsm_tls_finish (
        hsm_hdl_t key_management_hdl,
        op_tls_finish_args_t * args )
```

This command is designed to compute the verify_data block required for the Finished message in the TLS handshake.
The input key must be a master_secret key generated by a previous hsm_key_exchange call using a TLS KDF.
User can call this function only after having opened a key management service flow.

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key store management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.20 Standalone butterfly key expansion

### Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

### Data Structures

- struct op_st_butt_key_exp_args_t

### Macros

- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_UPDATE ((hsm_op_st_but_key_exp_flags_t)(1u << 0))

  *User can replace an existing key only by generating a key with the same type of the original one.*
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_CREATE ((hsm_op_st_but_key_exp_flags_t)(1u << 1))

  *Create a new key.*
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_IMPLICIT_CERTIF ((hsm_op_st_but_key_exp_flags_t)(0u << 2))

  *standalone butterfly key expansion using implicit certificate.*
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_EXPLICIT_CERTIF ((hsm_op_st_but_key_exp_flags_t)(1u << 2))

  *standalone butterfly key expansion using explicit certificate.*
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_STRICT_OPERATION ((hsm_op_st_but_key_exp_flags_t)(1u << 7))

  *The request is completed only when the new key has been written in the NVM.*

### Typedefs

- typedef uint8_t **hsm_op_st_but_key_exp_flags_t**

### Functions

- hsm_err_t hsm_standalone_butterfly_key_expansion (hsm_hdl_t key_management_hdl, op_st_butt_key_exp_args_t ∗args)

### 5.20.1 Detailed Description

### 5.20.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint32_t | key_identifier | identifier of the key to be expanded. |
| uint32_t | expansion_fct_key_identifier | identifier of the key to be use for the expansion function computation |
| uint8_t ∗ | expansion_fct_input | pointer to the input used to compute the expansion function |

### Data Fields

| | | |
|---|---|---|
| uint8_t ∗ | hash_value | pointer to the hash value input.<br>In case of explicit certificate, the hash value address must be set to 0. |
| uint8_t ∗ | pr_reconstruction_value | pointer to the private reconstruction value input.<br>In case of explicit certificate, the pr_reconstruction_value address must be set to 0. |
| uint8_t | expansion_fct_input_size | length in bytes of the expansion function input.<br>It msut be 16 bytes. |
| uint8_t | hash_value_size | length in bytes of the hash value input.<br>In case of explicit certificate, the hash_value_size parameter must be set to 0. |
| uint8_t | pr_reconstruction_value_size | length in bytes of the private reconstruction value input.<br>In case of explicit certificate, the pr_reconstruction_value_size parameter must be set to 0. |
| hsm_op_st_but_key_exp_flags_t | flags | bitmap specifying the operation properties |
| uint32_t ∗ | dest_key_identifier | pointer to identifier of the derived key to be used for the operation.<br>In case of create operation the new destination key identifier will be stored in this location. |
| uint8_t ∗ | output | pointer to the output area where the public key must be written. |
| uint16_t | output_size | length in bytes of the generated key, if the size is 0, no key is copied in the output. |
| hsm_key_type_t | key_type | indicates the type of the key to be derived. |
| uint8_t | expansion_fct_algo | cipher algorithm to be used for the expansion function computation |
| hsm_key_group_t | key_group | it must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API |
| hsm_key_info_t | key_info | bitmap specifying the properties of the derived key. |

#### 5.20.2.1 struct op_st_butt_key_exp_args_t

### 5.20.3 Function Documentation

#### 5.20.3.1 hsm_standalone_butterfly_key_expansion()

```
hsm_err_t hsm_standalone_butterfly_key_↩
expansion (
            hsm_hdl_t key_management_hdl,
            op_st_butt_key_exp_args_t ∗ args )
```

This command is designed to perform a standalone butterfly key expansion operation on an ECC private key in case of implicit and explicit certificates. Optionally the resulting public key is exported.
The standalone butterfly key expansion computes the expansion function in addition to the butterfly key expansion The expansion function is defined as: f_k = (cipher(k, x+1) xor (x+1)) || (cipher(k, x+2) xor (x+2)) || (cipher(k, x+3) xor (x+3)) mod l

- Cipher = AES 128 ECB or SM4 128 ECB
- K: the expansion function key
- X: is expansion function the input
- l: the order of the group of points on the curve.
  User can call this function only after having opened a key management service flow.

  Explicit certificates:

f_k = expansion function value

out_key = Key + f_k

Implicit certificates:

- f_k = expansion function value,
- hash = hash value used in the derivation of the pseudonym ECC key,
- pr_v = private reconstruction value

out_key = (Key + f_k)∗hash + pr_v

**Parameters**

| | |
|---|---|
| *key_management_hdl* | handle identifying the key store management service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.21 Key generic crypto service

### Modules

- i.MX8QXP specificities

### Data Structures

- struct open_svc_key_generic_crypto_args_t
- struct op_key_generic_crypto_args_t

### Macros

- #define HSM_KEY_GENERIC_ALGO_SM4_CCM ((hsm_op_key_generic_crypto_algo_t)(0x10u))

  *Perform SM4 CCM with following characteristics: SM4 CCM where AAD supported, Tag len = {4, 6, 8, 10, 12, 14, 16} bytes, IV len = {7, 8, 9, 10, 11, 12, 13} bytes.*
- #define **HSM_KEY_GENERIC_FLAGS_DECRYPT** ((hsm_op_key_generic_crypto_flags_t)(0u << 0))
- #define **HSM_KEY_GENERIC_FLAGS_ENCRYPT** ((hsm_op_key_generic_crypto_flags_t)(1u << 0))

### Typedefs

- typedef uint8_t **hsm_svc_key_generic_crypto_flags_t**
- typedef uint8_t **hsm_op_key_generic_crypto_algo_t**
- typedef uint8_t **hsm_op_key_generic_crypto_flags_t**

### Functions

- hsm_err_t hsm_open_key_generic_crypto_service (hsm_hdl_t session_hdl, open_svc_key_generic_crypto_args_t ∗args, hsm_hdl_t ∗key_generic_crypto_hdl)
- hsm_err_t hsm_close_key_generic_crypto_service (hsm_hdl_t key_generic_crypto_hdl)
- hsm_err_t hsm_key_generic_crypto (hsm_hdl_t key_generic_crypto_hdl, op_key_generic_crypto_args_t ∗args)

### 5.21.1 Detailed Description

### 5.21.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| hsm_svc_key_generic_crypto_flags_t | flags | bitmap indicating the service flow properties |
| uint8_t | reserved[3] | |

#### 5.21.2.1 struct open_svc_key_generic_crypto_args_t

**Data Fields**

| | | |
|---|---|---|
| uint8_t ∗ | key | pointer to the key to be used for the cryptographic operation |
| uint8_t | key_size | length in bytes of the key |
| uint8_t ∗ | iv | pointer to the initialization vector |
| uint16_t | iv_size | length in bytes of the initialization vector |
| uint8_t ∗ | aad | pointer to the additional authentication data |
| uint16_t | aad_size | length in bytes of the additional authentication data |
| uint8_t | tag_size | length in bytes of the tag |
| hsm_op_key_generic_crypto_algo_t | crypto_algo | algorithm to be used for the cryptographic operation |
| hsm_op_key_generic_crypto_flags_t | flags | bitmap specifying the cryptographic operation attributes |
| uint8_t ∗ | input | pointer to the input area<br>plaintext for encryption<br>ciphertext + tag for decryption |
| uint8_t ∗ | output | pointer to the output area<br>ciphertext + tag for encryption<br>plaintext for decryption if the tag is verified |
| uint32_t | input_size | length in bytes of the input |
| uint32_t | output_size | length in bytes of the output |
| uint32_t | reserved | |

#### 5.21.2.2 struct op_key_generic_crypto_args_t

### 5.21.3 Function Documentation

#### 5.21.3.1 hsm_open_key_generic_crypto_service()

```
hsm_err_t hsm_open_key_generic_crypto_service (
        hsm_hdl_t session_hdl,
        open_svc_key_generic_crypto_args_t ∗ args,
        hsm_hdl_t ∗ key_generic_crypto_hdl )
```

Open a generic crypto service flow.
User can call this function only after having opened a session.
User must open this service in order to perform key generic cryptographic operations.

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |
| *key_generic_crypto_hdl* | pointer to where the key generic cryto service flow handle must be written. |

**Returns**

error code

#### 5.21.3.2 hsm_close_key_generic_crypto_service()

```
hsm_err_t hsm_close_key_generic_crypto_service (
            hsm_hdl_t key_generic_crypto_hdl )
```

Terminate a previously opened key generic service flow.

**Parameters**

| | |
|---|---|
| *key_generic_crypto_hdl* | handle identifying the key generic service flow to be closed. |

**Returns**

error code

#### 5.21.3.3 hsm_key_generic_crypto()

```
hsm_err_t hsm_key_generic_crypto (
            hsm_hdl_t key_generic_crypto_hdl,
            op_key_generic_crypto_args_t * args )
```

Perform key generic crypto service operations
User can call this function only after having opened a key generic crypto service flow

**Parameters**

| | |
|---|---|
| *key_generic_crypto_hdl* | handle identifying the key generic cryto service flow. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.22 Dump Firmware Log

### Data Structures

- struct op_debug_dump_args_t

### Functions

- hsm_err_t **dump_firmware_log** (hsm_hdl_t session_hdl)

### 5.22.1 Detailed Description

### 5.22.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| bool | is_dump_pending | |
| uint32_t | dump_buf_len | |
| uint32_t | dump_buf[MAC_BUFF_LEN] | |

#### 5.22.2.1 struct op_debug_dump_args_t

## 5.23 Dev attest

### Data Structures

- struct op_dev_attest_args_t

### Functions

- hsm_err_t hsm_dev_attest (hsm_hdl_t sess_hdl, op_dev_attest_args_t ∗args)

### 5.23.1 Detailed Description

### 5.23.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint16_t | soc_id | |
| uint16_t | soc_rev | |
| uint16_t | lmda_val | |
| uint8_t | ssm_state | |
| uint8_t | uid_sz | |
| uint8_t ∗ | uid | |
| uint16_t | rom_patch_sha_sz | |
| uint16_t | sha_fw_sz | |
| uint8_t ∗ | sha_rom_patch | |
| uint8_t ∗ | sha_fw | |
| uint32_t | nounce | |
| uint32_t | rsp_nounce | |
| uint8_t | attest_result | |
| uint8_t | reserved | |
| uint16_t | sign_sz | |
| uint8_t ∗ | signature | |

#### 5.23.2.1 struct op_dev_attest_args_t

### 5.23.3 Function Documentation

#### 5.23.3.1 hsm_dev_attest()

```
hsm_err_t hsm_dev_attest (
        hsm_hdl_t sess_hdl,
        op_dev_attest_args_t ∗ args )
```

Perform device attestation operation
User can call this function only after having opened the session.

**Parameters**

| | |
|---|---|
| *sess_hdl* | handle identifying the active session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.24 Dev Info

### Data Structures

- struct op_dev_getinfo_args_t

### Functions

- hsm_err_t hsm_dev_getinfo (hsm_hdl_t sess_hdl, op_dev_getinfo_args_t ∗args)

### 5.24.1 Detailed Description

### 5.24.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| uint16_t | soc_id | |
| uint16_t | soc_rev | |
| uint16_t | lmda_val | |
| uint8_t | ssm_state | |
| uint8_t | uid_sz | |
| uint8_t ∗ | uid | |
| uint16_t | rom_patch_sha_sz | |
| uint16_t | sha_fw_sz | |
| uint8_t ∗ | sha_rom_patch | |
| uint8_t ∗ | sha_fw | |
| uint16_t | oem_srkh_sz | |
| uint8_t ∗ | oem_srkh | |
| uint8_t | imem_state | |
| uint8_t | csal_state | |
| uint8_t | trng_state | |

#### 5.24.2.1 struct op_dev_getinfo_args_t

### 5.24.3 Function Documentation

#### 5.24.3.1 hsm_dev_getinfo()

```
hsm_err_t hsm_dev_getinfo (
        hsm_hdl_t sess_hdl,
        op_dev_getinfo_args_t ∗ args )
```

Perform device attestation operation
User can call this function only after having opened the session.

**Parameters**

| | |
|---|---|
| *sess_hdl* | handle identifying the active session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.25 Generic Crypto: Asymmetric Crypto

### Data Structures

- struct op_gc_acrypto_args_t

### Macros

- #define **HSM_OP_GC_ACRYPTO_FLAGS_INPUT_MESSAGE** ((hsm_op_gc_acrypto_flags_t)(1u << 0))
- #define **HSM_GC_ACRYPTO_VERIFICATION_SUCCESS** ((hsm_gc_acrypto_verification_status_t)(0x5↩ A3CC3A5u))
- #define **HSM_GC_ACRYPTO_VERIFICATION_FAILURE** ((hsm_gc_acrypto_verification_status_t)(0x2↩ B4DD4B2u))

### Typedefs

- typedef uint8_t **hsm_op_gc_acrypto_flags_t**
- typedef uint32_t **hsm_gc_acrypto_verification_status_t**

### Enumerations

- enum hsm_op_gc_acrypto_algo_t {
**HSM_GC_ACRYPTO_ALGO_ECDSA_SHA224** = ALGO_ECDSA_SHA224,
**HSM_GC_ACRYPTO_ALGO_ECDSA_SHA256** = ALGO_ECDSA_SHA256,
**HSM_GC_ACRYPTO_ALGO_ECDSA_SHA384** = ALGO_ECDSA_SHA384,
**HSM_GC_ACRYPTO_ALGO_ECDSA_SHA512** = ALGO_ECDSA_SHA512,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_V15_SHA224** = ALGO_RSA_PKCS1_V15_SHA224,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_V15_SHA256** = ALGO_RSA_PKCS1_V15_SHA256,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_V15_SHA384** = ALGO_RSA_PKCS1_V15_SHA384,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_V15_SHA512** = ALGO_RSA_PKCS1_V15_SHA512,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_PSS_MGF1_SHA224** = ALGO_RSA_PKCS1_PSS_MGF1_↩ SHA224,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_PSS_MGF1_SHA256** = ALGO_RSA_PKCS1_PSS_MGF1_↩ SHA256,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_PSS_MGF1_SHA384** = ALGO_RSA_PKCS1_PSS_MGF1_↩ SHA384,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_PSS_MGF1_SHA512** = ALGO_RSA_PKCS1_PSS_MGF1_↩ SHA512,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_V15_CRYPT** = ALGO_RSA_PKCS1_V15_CRYPT,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_OAEP_SHA1** = ALGO_RSA_PKCS1_OAEP_SHA1,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_OAEP_SHA224** = ALGO_RSA_PKCS1_OAEP_SHA224,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_OAEP_SHA256** = ALGO_RSA_PKCS1_OAEP_SHA256,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_OAEP_SHA384** = ALGO_RSA_PKCS1_OAEP_SHA384,
**HSM_GC_ACRYPTO_ALGO_RSA_PKCS1_OAEP_SHA512** = ALGO_RSA_PKCS1_OAEP_SHA512 }

  *< Algorithms to be used for the operations*
- enum **hsm_gc_acrypto_op_mode_t** {
**HSM_GC_ACRYPTO_OP_MODE_ENCRYPT** = 0x01,
**HSM_GC_ACRYPTO_OP_MODE_DECRYPT** = 0x02,
**HSM_GC_ACRYPTO_OP_MODE_SIGN_GEN** = 0x03,
**HSM_GC_ACRYPTO_OP_MODE_SIGN_VER** = 0x04 }

### Functions

- hsm_err_t hsm_gc_acrypto (hsm_hdl_t session_hdl, op_gc_acrypto_args_t ∗args)

### 5.25.1 Detailed Description

### 5.25.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| hsm_op_gc_acrypto_algo_t | algorithm | < algorithm to use for the operation indicates the operation mode |
| hsm_gc_acrypto_op_mode_t | op_mode | indicates operation flags |
| hsm_op_gc_acrypto_flags_t | flags | key size in bits |
| hsm_bit_key_sz_t | bit_key_sz | pointer to the data buffer 1: |
| uint8_t * | data_buff1 | pointer to the data buffer 2: |
| uint8_t * | data_buff2 | size in bytes of data buffer 1 |
| uint32_t | data_buff1_size | size in bytes of data buffer 2 |
| uint32_t | data_buff2_size | pointer to the key modulus buffer |
| uint8_t * | key_buff1 | pointer the key exponent, either private or public |
| uint8_t * | key_buff2 | size in bytes of the key buffer 1 |
| uint16_t | key_buff1_size | size in bytes of the key buffer 2 |
| uint16_t | key_buff2_size | RSA label address. |
| uint8_t * | rsa_label | RSA label size in bytes. |
| uint16_t | rsa_label_size | RSA salt length in bytes. |
| uint16_t | rsa_salt_len | expected plaintext length in bytes, returned by FW in case of |
| uint32_t | exp_plaintext_len | signature verification status |
| hsm_gc_acrypto_verification_status_t | verification_status | |

#### 5.25.2.1 struct op_gc_acrypto_args_t

### 5.25.3 Function Documentation

#### 5.25.3.1 hsm_gc_acrypto()

```
hsm_err_t hsm_gc_acrypto (
    hsm_hdl_t session_hdl,
    op_gc_acrypto_args_t * args )
```

This command is designed to perform the following operations: -Asymmetric crypto -encryption/decryption -signature generation/verification

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.26 Generic Crypto Asymmetric Key Generate

### Data Structures

- struct op_gc_akey_gen_args_t

### Functions

- hsm_err_t hsm_gc_akey_gen (hsm_hdl_t session_hdl, op_gc_akey_gen_args_t ∗args)

### 5.26.1 Detailed Description

### 5.26.2 Data Structure Documentation

**Data Fields**

| | | |
|---|---|---|
| uint8_t ∗ | modulus | < pointer to the output buffer of key modulus pointer to the output buffer of key private exponent |
| uint8_t ∗ | priv_buff | pointer to the input buffer containing key public exponent |
| uint8_t ∗ | pub_buff | size in bytes of the modulus buffer |
| uint16_t | modulus_size | size in bytes of the private exponent buffer |
| uint16_t | priv_buff_size | size in bytes of the public exponent buffer |
| uint16_t | pub_buff_size | indicates which type of keypair must be generated |
| hsm_key_type_t | key_type | size in bits of the keypair to be generated |
| hsm_bit_key_sz_t | bit_key_sz | |

#### 5.26.2.1 struct op_gc_akey_gen_args_t

### 5.26.3 Function Documentation

#### 5.26.3.1 hsm_gc_akey_gen()

```
hsm_err_t hsm_gc_akey_gen (
        hsm_hdl_t session_hdl,
        op_gc_akey_gen_args_t * args )
```

This command is designed to perform the following operations: -Generate asymmetric keys, without using FW keystore

**Parameters**

| | |
|---|---|
| *session_hdl* | handle identifying the current session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.27 Get Info

### Data Structures

- struct op_get_info_args_t

### Functions

- hsm_err_t hsm_get_info (hsm_hdl_t sess_hdl, op_get_info_args_t ∗args)

### 5.27.1 Detailed Description

### 5.27.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| uint32_t | user_sab_id | < Stores User identifier (32bits) Stores the chip unique identifier |
| uint8_t ∗ | chip_unique_id | Size of the chip unique identifier in bytes. |
| uint16_t | chip_unq_id_sz | Stores the chip monotonic counter value (16bits) |
| uint16_t | chip_monotonic_counter | Stores the chip current life cycle bitfield (16bits) |
| uint16_t | chip_life_cycle | Stores the module version (32bits) |
| uint32_t | version | Stores the module extended version (32bits) |
| uint32_t | version_ext | Stores the FIPS mode bitfield (8bits). Bitmask definition:<br>bit0 - FIPS mode of operation:<br>• value 0 - part is running in FIPS non-approved mode.<br>• value 1 - part is running in FIPS approved mode.<br>bit1 - FIPS certified part:<br>• value 0 - part is not FIPS certified.<br>• value 1 - part is FIPS certified.<br>bit2-7: reserved<br>• value 0. |
| uint8_t | fips_mode | |

#### 5.27.2.1 struct op_get_info_args_t

### 5.27.3 Function Documentation

#### 5.27.3.1 hsm_get_info()

```
hsm_err_t hsm_get_info (
        hsm_hdl_t sess_hdl,
        op_get_info_args_t * args )
```

Perform device attestation operation
User can call this function only after having opened the session.

**Parameters**

| | |
|---|---|
| *sess_hdl* | handle identifying the active session. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.28 Public key recovery

Public Key Recovery is now also known as Public Key Exportation, in PSA compliant APIs. The naming here has been kept unchanged, for backward compatibility and Non-PSA compliant APIs.

.

### Data Structures

- struct op_pub_key_recovery_args_t

### Typedefs

- typedef uint8_t **hsm_op_pub_key_recovery_flags_t**

### Functions

- hsm_err_t hsm_pub_key_recovery (hsm_hdl_t key_store_hdl, op_pub_key_recovery_args_t ∗args)

### 5.28.1 Detailed Description

Public Key Recovery is now also known as Public Key Exportation, in PSA compliant APIs. The naming here has been kept unchanged, for backward compatibility and Non-PSA compliant APIs.

.

### 5.28.2 Data Structure Documentation

Data Fields

| | | |
|---:|---|---|
| uint32_t | key_identifier | < pointer to the identifier of the key to be used for the operation pointer to the output area where the generated public key must be written |
| uint8_t ∗ | out_key | length in bytes of the output key |
| uint16_t | out_key_size | indicates the type of the key to be recovered |
| hsm_key_type_t | key_type | bitmap specifying the operation attributes, mandatory for non-PSA compliant platforms |
| hsm_op_pub_key_recovery_flags_t | flags | |

#### 5.28.2.1 struct op_pub_key_recovery_args_t

### 5.28.3 Function Documentation

#### 5.28.3.1 hsm_pub_key_recovery()

```
hsm_err_t hsm_pub_key_recovery (
        hsm_hdl_t key_store_hdl,
        op_pub_key_recovery_args_t * args )
```

Recover Public key from private key present in key store
User can call this function only after having opened a key store.

**Parameters**

| | |
|---|---|
| *key_store_hdl* | handle identifying the current key store. |
| *args* | pointer to the structure containing the function arguments. |

**Returns**

error code

## 5.29 LC update

### Data Structures

- struct op_lc_update_msg_args_t

### Enumerations

- enum **hsm_lc_new_state_t** {
**HSM_NXP_PROVISIONED_STATE** = (1u << 0),
**HSM_OEM_OPEN_STATE** = (1u << 1),
**HSM_OEM_CLOSE_STATE** = (1u << 3),
**HSM_OEM_FIELD_RET_STATE** = (1u << 4),
**HSM_NXP_FIELD_RET_STATE** = (1u << 5),
**HSM_OEM_LOCKED_STATE** = (1u << 7) }

### Functions

- hsm_err_t **hsm_lc_update** (hsm_hdl_t session_hdl, op_lc_update_msg_args_t ∗args)

### 5.29.1 Detailed Description

### 5.29.2 Data Structure Documentation

Data Fields

| | | |
|---|---|---|
| hsm_lc_new_state_t | new_lc_state | |

#### 5.29.2.1 struct op_lc_update_msg_args_t

## 5.30 Error codes

### Enumerations

- enum hsm_err_t {
  HSM_NO_ERROR = 0x0,
  HSM_INVALID_MESSAGE = 0x1,
  HSM_INVALID_ADDRESS = 0x2,
  HSM_UNKNOWN_ID = 0x3,
  HSM_INVALID_PARAM = 0x4,
  HSM_NVM_ERROR = 0x5,
  HSM_OUT_OF_MEMORY = 0x6,
  HSM_UNKNOWN_HANDLE = 0x7,
  HSM_UNKNOWN_KEY_STORE = 0x8,
  HSM_KEY_STORE_AUTH = 0x9,
  HSM_KEY_STORE_ERROR = 0xA,
  HSM_ID_CONFLICT = 0xB,
  HSM_RNG_NOT_STARTED = 0xC,
  HSM_CMD_NOT_SUPPORTED = 0xD,
  HSM_INVALID_LIFECYCLE = 0xE,
  HSM_KEY_STORE_CONFLICT = 0xF,
  HSM_KEY_STORE_COUNTER = 0x10,
  HSM_FEATURE_NOT_SUPPORTED = 0x11,
  HSM_SELF_TEST_FAILURE = 0x12,
  HSM_NOT_READY_RATING = 0x13,
  HSM_FEATURE_DISABLED = 0x14,
  HSM_KEY_GROUP_FULL = 0x19,
  HSM_CANNOT_RETRIEVE_KEY_GROUP = 0x1A,
  HSM_KEY_NOT_SUPPORTED = 0x1B,
  HSM_CANNOT_DELETE_PERMANENT_KEY = 0x1C,
  HSM_OUT_TOO_SMALL = 0x1D,
  HSM_CRC_CHECK_ERR = 0xB9,
  HSM_OEM_CLOSED_LC_SIGNED_MSG_VERIFICATION_FAIL = 0xF0,
  HSM_OEM_OPEN_LC_SIGNED_MSG_VERIFICATION_FAIL = 0xF0,
  HSM_FATAL_FAILURE = 0x29,
  HSM_SERVICES_DISABLED = 0xF4,
  HSM_UNKNOWN_WARNING = 0xFC,
  HSM_SIGNATURE_INVALID = 0xFD,
  HSM_UNKNOWN_ERROR = 0xFE,
  **HSM_GENERAL_ERROR** = 0xFF }

### 5.30.1 Detailed Description

### 5.30.2 Enumeration Type Documentation

#### 5.30.2.1 hsm_err_t enum hsm_err_t

Error codes returned by HSM functions.

**Enumerator**

| | |
|---|---|
| HSM_NO_ERROR | Success. The received message is invalid or unknown. |

Enumerator

| | |
|---|---|
| HSM_INVALID_MESSAGE | The provided address is invalid or doesn’t respect the API requirements. |
| HSM_INVALID_ADDRESS | The provided identifier is not known. |
| HSM_UNKNOWN_ID | One of the parameter provided in the command is invalid. |
| HSM_INVALID_PARAM | NVM generic issue. |
| HSM_NVM_ERROR | There is not enough memory to handle the requested operation. |
| HSM_OUT_OF_MEMORY | Unknown session/service handle. |
| HSM_UNKNOWN_HANDLE | The key store identified by the provided “key store Id” doesn’t exist and the “create” flag is not set. |
| HSM_UNKNOWN_KEY_STORE | Key store authentication fails. |
| HSM_KEY_STORE_AUTH | An error occurred in the key store internal processing. |
| HSM_KEY_STORE_ERROR | An element (key store, key. . . ) with the provided ID already exists. |
| HSM_ID_CONFLICT | The internal RNG is not started. |
| HSM_RNG_NOT_STARTED | The functionality is not supported for the current session/service/key store configuration. |
| HSM_CMD_NOT_SUPPORTED | Invalid lifecycle for requested operation. |
| HSM_INVALID_LIFECYCLE | A key store with the same attributes already exists. |
| HSM_KEY_STORE_CONFLICT | The current key store reaches the max number of monotonic counter updates, updates are still allowed but monotonic counter will not be blown. |
| HSM_KEY_STORE_COUNTER | The requested feature is not supported by the firwware. |
| HSM_FEATURE_NOT_SUPPORTED | Self tests report an issue |
| HSM_SELF_TEST_FAILURE | The HSM is not ready to handle the current request |
| HSM_NOT_READY_RATING | The required service/operation is disabled |
| HSM_FEATURE_DISABLED | Not enough space to store the key in the key group |
| HSM_KEY_GROUP_FULL | Impossible to retrieve key group |
| HSM_CANNOT_RETRIEVE_KEY_GROUP | Key not supported |
| HSM_KEY_NOT_SUPPORTED | Trying to delete a permanent key |
| HSM_CANNOT_DELETE_PERMANENT_KEY | Output buffer size is too small |
| HSM_OUT_TOO_SMALL | Command CRC check error |
| HSM_CRC_CHECK_ERR | In OEM closed lifecycle, Signed message signature verification failure |
| HSM_OEM_CLOSED_LC_SIGNED_MSG_VERIFI↩ CATION_FAIL | Warning: In OEM open lifecycles, Signed message signature verification failure |
| HSM_OEM_OPEN_LC_SIGNED_MSG_VERIFIC↩ ATION_FAIL | A fatal failure occurred, the HSM goes in unrecoverable error state not replying to further requests |
| HSM_FATAL_FAILURE | Message neither handled by ROM nor FW |
| HSM_SERVICES_DISABLED | Unknown warnings |
| HSM_UNKNOWN_WARNING | Failure in verification status of operations such as MAC verification, Signature verification. |
| HSM_SIGNATURE_INVALID | Unknown errors |
| HSM_UNKNOWN_ERROR | Error in case General Error is received |

## 5.31 i.MX8QXP specificities

### Session

i.MX8QXP HSM is implemented only on SECO core which doesn't offer priority management neither low latencies.

- HSM_OPEN_SESSION_FIPS_MODE_MASK not supported and ignored
- HSM_OPEN_SESSION_EXCLUSIVE_MASK not supported and ignored
- session_priority field of open_session_args_t is ignored.
- HSM_OPEN_SESSION_LOW_LATENCY_MASK not supported and ignored.

### Key management

- HSM_OP_MANAGE_KEY_GROUP_FLAGS_DELETE is not supported.
- HSM_KEY_TYPE_ECDSA_NIST_P521 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_320 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_512 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_256 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_320 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_384 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_512 is not supported.
- HSM_KEY_TYPE_DSA_SM2_FP_256 is not supported.
- HSM_KEY_TYPE_SM4_128 is not supported.
- HSM_KEY_TYPE_HMAC_224 is not supported.
- HSM_KEY_TYPE_HMAC_256 is not supported.
- HSM_KEY_TYPE_HMAC_384 is not supported.
- HSM_KEY_TYPE_HMAC_512 is not supported.
- hsm_butterfly_key_expansion: This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_butt_key_exp_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

### Signature verification

- HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL is not supported
- hsm_import_public_key: This API is not supported

### Public key reconstruction

- This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.

- hsm_key_type_t of op_pub_key_rec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY↩_TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

### Public key decompression

- This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.

### ECIES encryption

- hsm_ecies_encryption: This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_ecies_enc_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_T↩YPE_ECDSA_BRAINPOOL_R1_256 are supported.

### SM2 Get Z

- This API is not supported.

### SM2 ECES decryption

- All the APIs related the SM2 ECES decryption are not supported.

### SM2 ECES encryption

- This API is not supported.

### Key exchange

- HSM_KDF_HMAC_SHA_256_TLS_0_16_4 is not supported.
- HSM_KDF_HMAC_SHA_384_TLS_0_32_4 is not supported.
- HSM_KDF_HMAC_SHA_256_TLS_0_32_4 is not supported.
- HSM_KDF_HMAC_SHA_256_TLS_32_16_4 is not supported.
- HSM_KDF_HMAC_SHA_384_TLS_48_32_4 is not supported.
- hsm_tls_finish API is not supported.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA256 is not supported.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA384 is not supported.
- HSM_OP_TLS_FINISH_FLAGS_CLIENT is not supported.
- HSM_OP_TLS_FINISH_FLAGS_SERVER is not supported.
- HSM_KE_SCHEME_ECDH_BRAINPOOL_T1_256 is not supported.

### Standalone butterfly key expansion

- This API is not supported.

### Key generic crypto service

- This API is not supported.

### Ciphering

- HSM_CIPHER_ONE_GO_ALGO_SM4_ECB is not supported.
- HSM_CIPHER_ONE_GO_ALGO_SM4_CBC is not supported.
- HSM_AUTH_ENC_ALGO_SM4_CCM is not supported.
- hsm_ecies_decryption: This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_ecies_dec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_T↩YPE_ECDSA_BRAINPOOL_R1_256 are supported.

### Signature generation

- HSM_HASH_ALGO_SM3_256 is not supported.

### Mac

- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_224 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_256 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_384 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_512 is not supported.

### Signature generation

- HSM_SIGNATURE_SCHEME_ECDSA_NIST_P521_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_256_SHA_256 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_384_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3 is not supported.

### Key store

The table below summarizes the maximum number of keys per group in the QXP implementation:

| Key size (bits) | Number of keys per group |
|---|---|
| 128 | 169 |
| 192 | 126 |
| 224 | 101 |
| 256 | 101 |
| 384 | 72 |
| 512 | 56 |

## 5.32 i.MX8DXL specificities

### Session

i.MX8DXL has 2 separate implementations of HSM on SECO and on V2X cores.

- HSM_OPEN_SESSION_FIPS_MODE_MASK not supported and ignored
- HSM_OPEN_SESSION_EXCLUSIVE_MASK not supported and ignored
- If HSM_OPEN_SESSION_LOW_LATENCY_MASK is unset then SECO implementation will be used. In this case session_priority field of open_session_args_t is ignored.
- If HSM_OPEN_SESSION_LOW_LATENCY_MASK is set then V2X implementation is used. session_priority field of open_session_args_t and HSM_OPEN_SESSION_NO_KEY_STORE_MASK are considered.

### Key management

- HSM_OP_MANAGE_KEY_GROUP_FLAGS_DELETE is not supported.
- HSM_KEY_TYPE_HMAC_224 is not supported.
- HSM_KEY_TYPE_HMAC_256 is not supported.
- HSM_KEY_TYPE_HMAC_384 is not supported.
- HSM_KEY_TYPE_HMAC_512 is not supported.
- hsm_key_type_t of op_butt_key_exp_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256, HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 and HSM_KEY_TYPE_DSA_SM2_FP_256 are supported.

### Signature verification

- HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT is not supported, in case of HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3.
- HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL is not supported
- hsm_import_public_key: This API is a preliminary version

### Public key reconstruction

- hsm_key_type_t of op_pub_key_rec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256, HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 and HSM_KEY_TYPE_DSA_SM2_FP_256 are supported.

### ECIES encryption

- hsm_key_type_t of op_ecies_enc_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

### SM2 ECES decryption

- The output_size should be a multiple of 4 bytes.

### SM2 ECES encryption

- The output_size should be a multiple of 4 bytes.

### Key exchange

- HSM_KDF_HMAC_SHA_256_TLS_0_16_4 is not supported.
- HSM_KDF_HMAC_SHA_384_TLS_0_32_4 is not supported.
- HSM_KDF_HMAC_SHA_256_TLS_0_32_4 is not supported.
- HSM_KDF_HMAC_SHA_256_TLS_32_16_4 is not supported.
- HSM_KDF_HMAC_SHA_384_TLS_48_32_4 is not supported.
- hsm_tls_finish API is not supported.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA256 is not supported.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA384 is not supported.
- HSM_OP_TLS_FINISH_FLAGS_CLIENT is not supported.
- HSM_OP_TLS_FINISH_FLAGS_SERVER is not supported.

### Standalone butterfly key expansion

hsm_key_type_t of op_butt_key_exp_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256, HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 and HSM_KEY_TYPE_DSA_SM2_FP_256 are supported.

### Ciphering

- hsm_key_type_t of op_ecies_dec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

### Mac

- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_224 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_256 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_384 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_512 is not supported.

### Signature generation

- HSM_OP_GENERATE_SIGN_FLAGS_COMPRESSED_POINT is not supported, in case of HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3.

### Key store

The table below summarizes the maximum number of keys per group in the DXL implementation:

sessions using V2X implementation (HSM_OPEN_SESSION_LOW_LATENCY_MASK) :

| Key size (bits) | Number of keys per group |
|---|---|
| 128 | 166 |
| 192 | 125 |
| 224 | 111 |
| 256 | 100 |
| 384 | 71 |
| 512 | 52 |

session using SECO implementation : same number as QXP applies

# Index